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SETTING INTERNATIONAL STANDARDS

Technological Rationality or Primacy of Power?

By WALTER MATTLI and TIM BÜTHE*

The principles of standardization are irreducible to . . . [a] system of states locked in competition for political, military, and economic domination. . . . [T]he competitive struggle between states is not permitted to shape the products of global standards organizations.

—*Thomas Loya and John Boli*

[And] although the considerations of the standard tend to be expressed in rather technical language, behind this façade of engineering jargon, what is actually happening is an economic fight, often of the most savage type imaginable because the stakes are so high.

—*Federal Trade Commission*

INTRODUCTION

UNTIL the 1980s standards setting had been primarily an internal matter for firms or the domain of private sector technical bodies at the national level. Each country produced its own standards without much regard for what others were doing. International standards were

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Epigraphs. Loya and Boli, "Standardization in the World Polity," in John Boli and George Thomas, *Constructing World Culture: International Nongovernmental Organizations since 1875* (Stanford, Calif.: Stanford University Press, 1999), 196; Federal Trade Commission, *Standards and Certification: Proposed Rules, and Staff Report* (Washington, D.C.: FTC, 1978), 94.

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few and far between, prescribing specifications for widely used products such as thickness of credit cards (0.76 mm), the sensitivity of photographic film (ISO ratings), the dimensions of freight containers, the thread pitch of screws, and the reference temperature for measurements of industrial length.¹

A series of revolutionary technological changes in the last two decades and rapid economic integration at the regional and global levels have fundamentally altered this once placid world of standards and standards-developing organizations (SDOs).² Specifically, these developments have triggered a remarkable growth in the number of international and regional standards, even while the production of national technical specifications has declined (see Figure 1). They have raised the economic and political salience of what were once considered merely “technical” specifications.

International trade is one of the areas in which standards now play a central role. According to a recent study, up to 80 percent of trade (equivalent to about \$4 trillion annually) is affected by standards or associated technical regulations.³ Whereas differing national standards act as nontariff barriers to trade, harmonized international or regional standards increasingly serve as instruments of trade liberalization. For example, the Agreement on Technical Barriers to Trade of the World Trade Organization (WTO) states that “where technical regulations are required and relevant international standards exist or their completion is imminent, Members shall use them . . . as a basis for their technical regulations.”⁴ Failure to use international standards may be found to constitute an “unnecessary obstacle” to trade and thus a violation of WTO law.

Notwithstanding the growing economic and legal significance of international standards, standards setting has until very recently received scant attention from scholars and nonscholars alike. Standards seemed

¹ See International Organization for Standardization (ISO), *Friendship among Equals: Recollections from ISO's First Fifty Years* (Geneva: ISO Central Secretariat, 1997); and Thomas Loya and John Boli, “Standardization in the World Polity,” in John Boli and George Thomas, eds., *Constructing World Culture: International Nongovernmental Organizations since 1875* (Stanford, Calif.: Stanford University Press, 1999).

² Compatibility standards, for example, have risen in prominence with the explosive growth of information and telecommunications technologies. People want to participate in networks that allow them to share databases, have access to large selections of compatible software, exchange documents, combine products made by different vendors, or simply communicate directly. See Stanley Besen and Joseph Farrell, “Choosing How to Compete: Strategies and Tactics in Standardization,” *Journal of Economic Perspectives* 8 (Spring 1994).

³ Organization for Economic Cooperation and Development, *Regulatory Reform and International Standardization* (Paris: OECD Working Party of the Trade Committee, 1999), 4.

⁴ GATT TBT Agreement, article 2.4. The TBT Agreement is reprinted inter alia in Alan Sykes, *Product Standards for Internationally Integrated Goods Markets* (Washington, D.C.: Brookings Institution, 1995), 169–214.

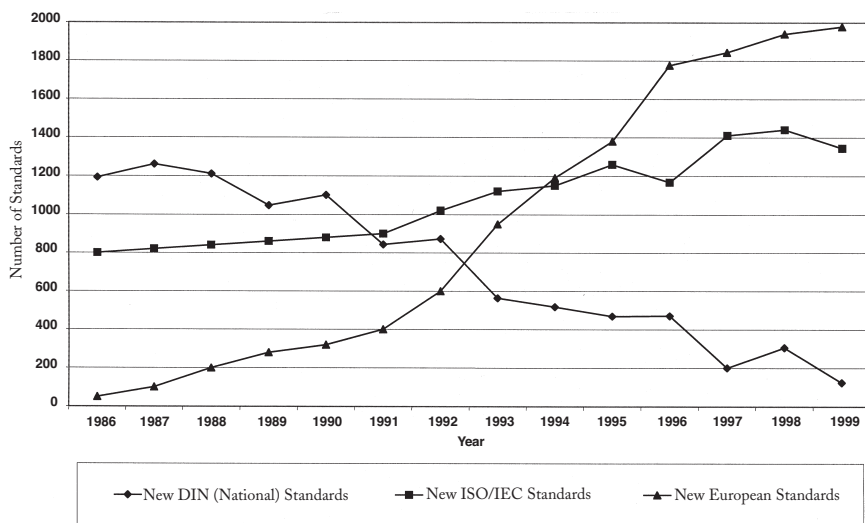


FIGURE 1
NEW INTERNATIONAL (ISO AND IEC), EUROPEAN, AND NATIONAL
(GERMAN, I.E., DIN) STANDARDS PER YEAR
(1986–99)

invisible to all but a few experts in engineering and related fields. And with the exception of some economists and legal scholars, social scientists deemed standardization unworthy of their attention—the topic seemed hopelessly technical and dry. But is it? The answer is an emphatic no. The study of international standardization raises the kinds of questions familiar to students of international relations, including: Who sets international rules? Do international standards benefit all or are there winners and losers, either in relative or absolute terms? What is the role of power and institutions in international disputes or bargains over standards? What defines power and how does it operate?

We focus in this article on a broad class of standards that is pivotal in international trade: product-related standards. Product standards are technical specifications of design and performance characteristics of manufactured goods.⁵ The vast majority of these standards emanate from private sector standards developing organizations (SDOs). The two key international SDOs are the International Organization for Stand-

⁵More specifically, product standards cover properties such as interoperability, interconnectability, levels of safety, conformity, materials, systems of classification, methods of testing, the operation of systems, and quality assurance. For an excellent overview of different types of international standards, see Kenneth Abbott and Duncan Snidal, “International ‘Standards’ and International Governance,” *Journal of European Public Policy* 8, no. 3 (2001).

ardization (ISO) and the International Electro-technical Commission (IEC). Although membership is by country, ISO and IEC are private sector organizations, in which states and governments themselves cannot be members. These international nongovernmental organizations are best described as global networks comprising hundreds of technical committees from all over the world and involving tens of thousands of experts representing industry and other groups. The institutional backbone of these networks is formed by private sector standards bodies at the national level. Domestic bodies thus are part and parcel of the international institutional structure.⁶

The core of this article offers a fresh analytical view of international standardization. This approach, which we call the *institutional complementarities* approach, accepts a fundamental premise of realist theory in international relations, namely, that rule making involves distributional conflicts, as summarized by the “Battle of the Sexes” coordination game. It also agrees that significant economic resources and technical expertise are prerequisites for active participation in international standardization. Yet unlike realism, it posits that such resources are necessary but not sufficient conditions for explaining first-mover advantage in institutionalized standards setting. What is missing from existing theoretical approaches is an appreciation of the central role played by domestic institutional arrangements—that is, institutional structures of national standardization systems that hail from the nineteenth and early twentieth centuries—as an intermediary force between domestic firms and global standards organizations. These institutional structures are starkly different between the two key players in international standardization, the Americans and the Europeans. We posit that domestic institutional differences result in cross-regional differences in “complementarity” between the national and international institutions of standardization, with important consequences for the ability of firms to be involved in international standardization. In other words, we argue that particular historical institutional legacies of national standardization systems play a critical though largely accidental role in placing domestic firms in a first- or second-mover position when standardization becomes global. First movers set the international standards agenda, and laggards, or second movers, pay the switching costs.

The study goes beyond simply postulating a new approach, however. It also offers empirical tests of the institutional complementarities approach and competing analytical views of international standardization.

⁶For the sake of brevity we henceforth refer to international product standardization simply as international standardization.

These tests are based on the first comprehensive data set on standardization, which was collected for this project through a multicountry internet survey.

By investigating the nature of international standardization, the study seeks to make contributions to several literatures, beginning with the institutional literature in international relations. Lisa Martin and Beth Simmons recently called for more research on *how*, not just whether, institutions matter in shaping international politics.⁷ This study heeds their call but takes a broader view of the *how* question, pondering not only the impact of international standards institutions but also the effect of complementarities between existing domestic institutional structures and international institutions.

The study seeks, second, to enrich international relations research by drawing attention to the central role played by private sector actors in a globalizing economy. Robert Keohane has argued that in a world of rapidly growing interdependence, intergovernmental institutional arrangements are established to correct market failures stemming from asymmetric information, moral hazard, risk, and uncertainty.⁸ This insight, though important, overlooks the significance of nonstate actors in international relations and assumes away the ability of such actors to tackle so-called market failures through the creation of private institutional arrangements. A careful assessment of the strengths and weaknesses of such arrangements would be an important step in the development of a framework for comparative institutional analysis permitting, for example, an assessment of the effectiveness and efficiency of intergovernmental institutional arrangements.⁹

Finally, the study seeks to fill a gaping hole in the theoretical literature on standards setting. This literature has been dominated by economists focused on market processes: Microsoft sets a *de facto* standard unilaterally and others are faced with the choice of jumping on the bandwagon or battling Microsoft in the marketplace with a superior standard. Much of this literature examines the conditions under which compatibility standards are subject to market failures.¹⁰ However, as mentioned above, the vast majority of international standards are pro-

⁷ Martin and Simmons, "Theories and Empirical Studies of International Institutions," *International Organization* 52 (Autumn 1998).

⁸ Keohane, *After Hegemony* (Princeton: Princeton University Press, 1984), 93.

⁹ Walter Mattli, "Public and Private Governance in Setting International Standards," in Miles Kahler and David Lake, eds., *Governance in a Global Economy: Political Authority in Transition* (Princeton: Princeton University Press, 2003); see also idem, "Private Justice in a Global Economy: From Litigation to Arbitration," *International Organization* 55 (August 2001).

¹⁰ For a good review, see Paul David and Shane Greenstein, "The Economics of Compatibility Standards," *Economics of Innovation and New Technology* 1, no. 1 (1990).

duced through institutions. Economists have yet to attempt to understand and assess the operation and performance of the main international standards institutions.

The article is organized as follows. Section I provides a brief empirical overview of the main processes and institutions in international standardization, preparing the ground for the subsequent analytical sections. Section II reviews two schools of thought in political science and sociology—realism and the world society approach in sociological institutionalism—which directly or indirectly address settings typical of standardization, that is, situations where actors are faced with the need to coordinate technical rules and regulations. Section III develops the institutional complementarities approach, describing two divergent models of national standardization and tracing the institutional mechanisms by which these models either benefit or disadvantage domestic firms in international standardization. Section IV reviews existing and largely anecdotal evidence as a preliminary empirical test of the hypotheses derived in the previous sections. Section V then subjects the competing theoretical claims to a series of more rigorous empirical tests, based on data from our international standards survey.

I. THE MAIN INTERNATIONAL STANDARDS INSTITUTIONS

Since international standardization has been an understudied subject, we begin with a sketch of its main institutions and procedures. The most notable international private sector standards-setting institution is ISO. Established in 1947, it is responsible for the largest number of international standards and covers a wide range of economic sectors, from agriculture and construction to mechanical engineering to the newest developments in information technology.¹¹ ISO's sister organization, IEC, was founded in 1906 with a mandate to produce standards in the area of electrical and electronic engineering.¹² Both ISO and IEC were little-known organizations and produced relatively few standards until the 1980s, as they stood in the shadow of powerful national organizations such as DIN (the German Institute for Standardization) or

¹¹ ISO is the product of a merger between the International Federation of National Standardizing Associations (ISA), established in 1926, and the United Nations Standards Coordinating Committee (UNSCC) of 1944. The UNSCC had been set up by the United States, the United Kingdom, and Canada to bring the benefits of standardization to bear on the war effort and the work of reconstruction. Many of the statutes and rules of procedure of ISO were adopted from ISA. See ISO (fn. 1), 15.

¹²For historical information about IEC, see www.iec.ch/about/history/hentry-e.htm, accessed March 1, 2003.

BSI (the British Standards Institution). This changed, however, with the globalization of product markets: ISO and the IEC then found themselves catapulted to prominence. As of January 2003, ISO had produced more than 13,700 standards and IEC more than 4,500.¹³ Together the two account for approximately 85 percent of all known international standards, and their annual output has almost doubled since the early 1980s.¹⁴

ISO and IEC standards are voluntary, that is, ISO and IEC do not enforce their implementation. However, countries are increasingly adopting ISO standards (especially those dealing with health, safety, and the environment) as part of their national regulatory frameworks or referencing them as the technical basis in legislation.¹⁵ This practice is further encouraged by recent trade agreements, as mentioned above.

Membership in ISO is open to national bodies (one per country) “most broadly representative of standardization in their countries.”¹⁶ For the vast majority of industrialized countries, the national SDOs that serve as the country’s representative to ISO and IEC are private organizations. As of January 2003, ISO had ninety-four full voting members; IEC had fifty-one.¹⁷

The technical work of ISO is carried out by a large network of some 180 technical committees, 550 subcommittees, and 2,000 working groups; IEC standardization is conducted in some 170 technical committees and subcommittees and 530 working groups. In these forums some forty thousand experts—selected as representatives by the national SDOs, mostly from industry but also from research institutes, public regulatory agencies, and noncommercial interest groups—gather to tackle standardization issues.¹⁸ Their work is coordinated by two small central secretariats in Geneva.¹⁹

Funding of ISO (and IEC) standardization is private. ISO estimates the annual operational (administrative) expenditure for its standardization

¹³ See www.iso.ch/iso/en/aboutiso/isoinfigures/January2003-p2.html and www.iec.ch/news_centre/iec_figures/figures-e.htm, accessed March 1, 2003.

¹⁴ For further details on these organization, see www.iso.ch and www.iec.ch.

¹⁵ See, e.g., Nils Brunsson and Bengt Jacobsson, eds., *A World of Standards* (New York: Oxford University Press, 2000).

¹⁶ Article 3.1.1 of the Statutes of ISO.

¹⁷ In addition, both organizations offer other forms of membership for very small or developing countries.

¹⁸ This is an official estimate. Some interviewees contend that the number is as high as one hundred thousand; authors’ interviews with anonymous sources, Washington, D.C., August 31, 2000, and Paris, October 5, 2000.

¹⁹ The ISO central secretariat, for example, has a full-time staff of 163 from 25 countries.

work at about 140 million Swiss francs (U.S. \$103 million). Eighty percent is financed directly by thirty-six member bodies that hold technical committee and subcommittee secretariats; the remaining 20 percent, which comes from membership fees and publications income, covers the costs of the central secretariat.²⁰

There are five main stages in the ISO standards development process.²¹ In the first, which may be called the informal planning stage, the need for a standard is usually expressed by an industry sector, which communicates this need to the national SDO that is the country's ISO member. This national SDO, in turn, proposes the new work item to ISO. If ISO accepts the mandate, the second phase begins, in which ISO asks a working group comprising technical experts from countries interested in the subject matter to elaborate a definition of the technical scope of the future standard. The experts are appointed by and represent the national SDOs that are the official ISO members. Once the international working group reaches an agreement on the technical aspects to be covered by the standard, a third, technical committee phase is entered, during which a committee works out the detailed specifications.²² The committee produces a draft standard, which is circulated among ISO members and published for comments from the general public during the fourth, public inquiry phase. The technical committee then considers objections and requests for changes to the draft standard. Fifth, the committee presents a final draft standard for adoption.

This institutional arrangement is accompanied by a set of decision-making procedures intended to ensure broad support for the new standards but which also make it progressively more difficult to change proposals as they move through the five stages. Consensus procedures require that the conclusion of the early phases is reached without major objections by any participant in the technical committee carrying out the standardization work. For the final adoption of an ISO international standard, the rules require that two-thirds of committee members vote for the final draft and no more than one-quarter vote against it.²³ Therefore, if firms and other actors from a given country are to influence the technical specifications of an international standard, the country's SDO must get involved—preferably early on—in ISO standardization.

²⁰ See www.iso.ch/iso/en/aboutiso/isoinfigures/archives/January2003.pdf, accessed March 1, 2003.

²¹ The IEC process is practically identical.

²² Individual national standards bodies within the ISO membership take on the administrative responsibilities for different technical committees through holding "secretariats" for technical committees.

²³ If these conditions are not met, the draft standard is sent back to the relevant committee for reconsideration in the light of the technical reasons submitted in support of negative votes.

II. EXISTING THEORETICAL APPROACHES TO INTERNATIONAL STANDARDIZATION

In this section we review two schools of thought, sociological institutionalism (the world society approach), with its close affinity to IR constructivism, and political realism. These two approaches hold intrinsic importance for political science. But beyond that, our choice is motivated by the existence of at least one work in each school that applies it to issues of international cooperation in the realm of standards setting. Focusing especially on the theoretical arguments in those works, we draw out the implications of each approach for explaining the process of standardization in international nongovernmental organizations like ISO, where the bulk of international standards setting is conducted.

Sociological institutionalist and realist analyses share a common view of standardization as an exercise in coordination—coordination of different technical models, different engineering philosophies, different approaches to consumer protection, environmental regulation, and so on. However, the two approaches disagree about the nature of coordination. The following game-theoretic models nicely capture the essence of the different conceptions of coordination.²⁴

In simple coordination games, which underpin the world society view of standardization, actors seeking to coordinate technical rules and regulations have an overriding preference for arriving at a common solution. Either these actors may be entirely indifferent as to which standard to choose as the common one (Figure 2a), or they will agree that one standard is technically superior (Figure 2b).²⁵

Under these circumstances, coordination is easy—though still not automatic since there are two equilibria (XX and YY) and no dominant strategy.²⁶ Institutions may help by providing a forum for the exchange of information, so as to ensure, for instance, that the other player, too,

²⁴We here use 2×2 games with ordinal payoffs, where 1 indicates the least, 4 indicates the most desirable of the possible outcomes. These models are surely too simple as a description of the coordination problems of actual international standardization, which involves multiple actors and often multiple possible strategies, but they are very useful for heuristic purposes. As Duncan Snidal has pointed out, increasing the number of actors in coordination games (even with divergent interests as in Figure 3) does *not* impede cooperation “to nearly the same extent” as in a Prisoner’s Dilemma game, and it may even “facilitate cooperation in some cases”; Snidal, “Coordination versus Prisoners’ Dilemma: Implications for International Cooperation and Regimes,” *American Political Science Review* 79 (December 1985), 936; see also Arthur Stein, “Coordination and Collaboration: Regimes in an Anarchic World,” in Stephen Krasner, ed., *International Regimes* (Ithaca, N.Y.: Cornell University Press, 1983).

²⁵The game in Figure 2a has two Pareto-optimal Nash equilibria, and the game in Figure 2b has two Nash equilibria, one of which is Pareto optimal and one of which is not.

²⁶Note that even in the version depicted in Figure 2b, simple coordination is *not* a “harmony” game.

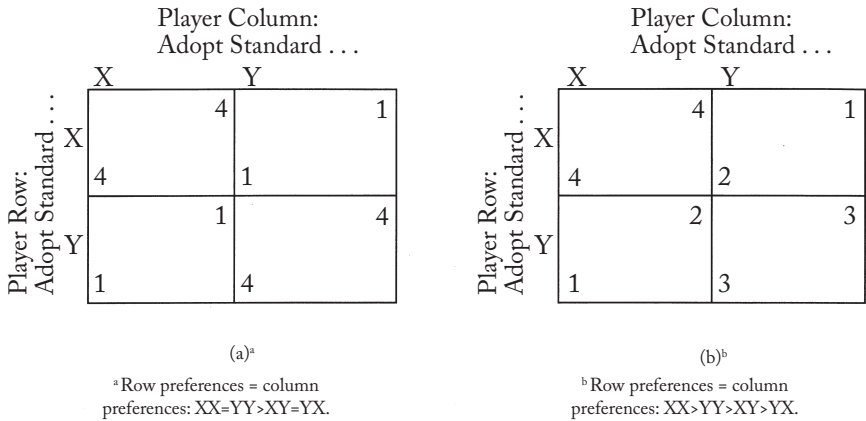


FIGURE 2
SIMPLE COORDINATION GAME

considers X technically superior in the type of scenarios shown in Figure 2b. Examples of such games are choosing which side of the road to drive on in the early period of the automobile (2a) and the use of metric measurements in collaborative scientific work (2b).²⁷

The analytically more complicated type of coordination is the so-called “Battle of the Sexes” game; it informs the realist view of standardization as well as our own analytical framework, the institutional complementarities approach. Players in a Battle of the Sexes game also have an overriding preference to come to a common solution, but they disagree about what the solution should be.²⁸ This game has two Nash-equilibrium outcomes, 4/3 and 3/4 (see Figure 3), each with distinct distributional implications.

Given the two-equilibria setup, the game implies that greater benefits will accrue to the player who is in a position to move first and communicate this move credibly and effectively to the other player(s)—and thus set the international standards agenda. It suggests that the central analytical question in such situations is what factors determine who will have this first-mover advantage? As David Kreps, Robert Gibbons, and

²⁷ Scientists tend to consider metric units clearly technically superior for computational reasons. Coordination, however, may be even more important since the lack of coordination raises the likelihood of mistakes, such as when Lockheed Martin Astronautics, using English units internally, overlooked converting one set of figures into metric units while working as a subcontractor for NASA’s Jet Propulsion Laboratory, which uses metric units throughout. The loss of NASA’s \$125 million Mars Climate Orbiter in September 1999 was widely attributed to this mistake; “Engineers’ Lapse Led to Loss of Mars Spacecraft,” *Washington Post*, October 1, 1999, A1.

²⁸ For early applications to international relations, see Thomas Schelling, *Strategy of Conflict* (Cambridge: Harvard University Press, 1960), 58–67, 135–36, 291–301.

Player Column: Adopt Standard . . .

		X	Y
		3	2
Player Row: Adopt Standard . . .	X	4	2
	Y	1	4
		1	3

FIGURE 3
COORDINATION GAME “BATTLE OF THE SEXES”^a

^aRow preferences: X>Y; XX>YY>XY>YX; column preferences: Y>X; YY>XX>YX>XY.
2 equilibria: XX, YY.

others have shown, the logic of game theory alone does not yield a unique solution in Battle of the Sexes–type games.²⁹ Additional assumptions are required to predict which player will be able to induce coordination on a particular (favorable) solution by moving first. We will discuss different analytical answers to the question in this section and the next.

SOCIOLOGICAL INSTITUTIONALISM GOES IR:
THE WORLD SOCIETY APPROACH

Sociologists Thomas Loya and John Boli have produced the first social-scientific study of institutionalized international standardization.³⁰ Their recent world polity analysis is based on the sociological institutionalist world society approach pioneered by John Meyer and coauthors. It has close affinities to the English school and the structural variant of social constructivism in international relations theory.³¹

²⁹ Robert Gibbons, *Game Theory for Applied Economists* (Princeton: Princeton University Press, 1992), 11–12; and David Kreps, *Game Theory and Economic Modeling* (New York: Oxford University Press, 1990), 100–102.

³⁰ Loya and Boli (fn. 1).

³¹ John Meyer and Brian Rowan, “Institutionalized Organizations: Formal Structure as Myth and Ceremony,” *American Journal of Sociology* 83 (September 1977); John Meyer, “The World Polity and the Authority of Nation State,” in Albert Bergesen, ed., *Studies in the Modern World-System* (New York: Academic Press, 1980); and John Meyer, John Boli, George Thomas, and Francisco Ramirez, “World Society and the Nation State,” *American Journal of Sociology* 103 (July 1997). For overviews of socio-

Sociological institutionalists interested in issues of international cooperation have primarily focused on how social institutions (broadly conceived) shape the identities and interests of actors and thus in turn facilitate—or impede—cooperation between states, as well as between nonstate actors.³² At the international level, they see a social structure that “constructs” individual and collective actors by providing them with models, “identities,” or “roles,” such as state, head of state, multinational firm, and so on.³³ Although “roles are not played in mechanical fashion according to precise scripts,”³⁴ actors behave (largely) in ways consistent with their role identities following a “logic of appropriateness.” The key criterion for choosing an action is therefore its appropriateness for one’s role rather than whether the consequences of that action are most beneficial.³⁵

The sociological institutionalist world society approach makes specific substantive assumptions for explaining organizational forms, as well as, potentially, the behavior of collective and individual actors at the international level.³⁶ Meyer and his followers see the modern international system as comprising an increasingly homogenous “world political culture” or even “world society” that has at its core Weberian notions of rationality, modernity, and progress³⁷ and more generally cognitive models that are “highly rationalized, articulated, and often surprisingly consensual.”³⁸

logical institutionalism, see Walter Powell and Paul DiMaggio, eds., *The New Institutionalism in Organizational Analysis* (Chicago: University of Chicago Press, 1991); Peter Hall and Rosemary Taylor, “Political Science and the Three New Institutionalisms,” *Political Studies* 44 (December 1996); and Martha Finnemore, “Norms, Culture, and World Politics: Insights from Sociology’s Institutionalism,” *International Organization* 50 (Spring 1996).

³²The potential of “negative” or conflictual role identities impeding international cooperation is brought out more explicitly by some constructivist scholars, for example, Alexander Wendt, “Anarchy Is What States Make of It,” *International Organization* 46 (Spring 1992), esp. 418.

³³See, e.g., Meyer et al. (fn. 31), 148. Because these models become operational only when they are internationally and transnationally “intersubjective,” or shared, they are at any given point in time largely “beyond the discretion of any individual participant”; Meyer and Rowan (fn. 31), 343.

³⁴Wendt (fn. 32), 419.

³⁵See James March and Johan Olsen, *Rediscovering Institutions: The Organizational Basis of Politics* (New York: Free Press, 1989), esp. 23–24, 160–62; and idem, “The Institutional Dynamics of International Political Orders,” *International Organization* 52 (Autumn 1998).

³⁶This sets world society theory apart from constructivism, which as such makes no substantive assumptions about the beliefs that constitute the international social structure and leaves open the possibility that actors’ material interests will counteract the normative/ideational demands created by social structure. Otherwise, many elements of world society theory exhibit close affinities to constructivist theories in IR. See, e.g., Jeffrey T. Checkel, “The Constructivist Turn in International Relations Theory,” *World Politics* 50 (January 1998); Yosef Lapid and Friedrich Kratochwil, *The Return of Culture and Identity in IR Theory* (Boulder, Colo.: Lynne Rienner, 1996); John Gerard Ruggie, *Constructing the World Polity* (London: Routledge, 1998); and Alexander Wendt, *A Social Theory of International Politics* (Cambridge: Cambridge University Press 1999), esp. 177–78, 181–84, 224–33, and ensuing debate.

³⁷Meyer (fn. 31); Meyer et al. (fn. 31, 1997).

³⁸Meyer et al. (fn. 31), 144. It is the assumed universality of the models of world society that allows this approach to explain similar behavior by dissimilar actors or actors with different interests; see Finnemore (fn. 31), esp. 334.

This results in external legitimization of states as the key actors in the international system, but it also culturally facilitates and empowers specific international *nongovernmental* organizational structures³⁹ and the associated epistemic communities of scientists and other professionals who “have become central and prestigious participants in world society” due to their “authority to assimilate and develop rationalized and universalistic knowledge.”⁴⁰ Consequently, the world society approach identifies as central concerns of international scholarship the identities of nonstate actors, the goals and purposes they adopt, the means they employ, and the causal logic they use to orient means to goals and purposes.

Loya and Boli apply this approach to the study of the organizational structure and operation of the two central institutions in international standardization, the “highly institutionalized” and “highly rationalized” ISO and IEC. They view these organizations as “built on world-cultural conceptions of universalism, rational progress, and egalitarianism.”⁴¹ Consequently, standards are primarily a function of science and technical considerations rather than a function of the distribution of power between national, regional, or nonstate actors. In particular, the “competitive struggle between states is not permitted to shape the products of global standards organizations.” States yield instead to the authority associated with technical expertise of private sector standards organizations and the principles of governance by which these organizations operate, including equality, fairness, and nonpartisanship.⁴² In short, technical rationality trumps power.

Central to Loya and Boli’s conception of international standardization is what they call a “complex web of mutual legitimation”:

Individuals, firms, and associations legitimate national [standards] bodies through the theory of rational voluntarism; national bodies legitimate the global bodies by making the latter transcendently inclusive. . . . The global bodies in turn legitimate national bodies by subjecting them to evaluation in accordance with universalistic, technically based criteria for admission and retention of membership, and they legitimate the technical experts who do the bulk of their work by the very act of selecting them for T[echnical] C[ommittee] membership.⁴³

Importantly, on neither theoretical nor empirical grounds do Loya and Boli see any of the “decoupling” or inconsistency between the formal structure of these international nongovernmental organizations

³⁹ Meyer (fn. 31), 145.

⁴⁰ *Ibid.*, 165.

⁴¹ Loya and Boli (fn. 1), 192.

⁴² *Ibid.*, 196.

⁴³ *Ibid.*, 194.

and their “actual day-to-day work activities” that Meyer and his colleagues had emphasized might occur.⁴⁴ Presumably due to the world cultural principles of scientific truth shared by participants in their roles as engineers, Loya and Boli portray the actual process of standardization in ISO and IEC as occurring in accordance with the principles of the standards bodies and with other, universal norms.⁴⁵ Not only do the “rules of nonpartisanship [of standards bodies] make all of humanity . . . the target beneficiaries of [international standardization]”⁴⁶ but actual participants in ISO and IEC standardization also see themselves and each other as partaking “in a unitary, coherent, necessary, and practically inevitable process.”⁴⁷ Consequently, they treat each other as equals. Agreeing on common standards is a simple coordination process abetted by world cultural principles of technical/engineering optimization directly embodied in and expressed by standards organizations. Technical consensus is easy because “scientific, technological knowledge is everywhere the same.”⁴⁸

In sum, the world society approach sees international standardization as a resolutely cooperative venture—devoid of distributional consequences and not reducible to the interests or relative power of regions, states, or firms. It is a simple coordination game along the lines of Figure 2b. Consequently, the approach predicts no systematic differences in firms’ experience with international standardization. And since there is no first-mover advantage in the simple coordination game, the approach also predicts no systematic differences in involvement.

We have doubts about how well this theory captures the central dynamics of international standardization. Most importantly, like many sociological institutionalist arguments, it is devoid of politics and contestation.⁴⁹ Considerations of differences in material interests and power are missing or even explicitly dismissed. Loya and Boli appear to see these omissions as justified by the world cultural norms that define standardization as a “technical” issue-area that is shielded from politics by the appeal to rulelike scientific procedures grounded in a broader norm of rationality. But such an argument rests on a simplistic notion of the natural and engineering sciences as realms in which knowledge is

⁴⁴ Meyer and Rowan (fn. 31), 341, 355–59; Meyer et al. (fn. 31), 149, 154–56.

⁴⁵ Loya and Boli (fn. 1), 193.

⁴⁶ *Ibid.*, 191.

⁴⁷ *Ibid.*

⁴⁸ *Ibid.*, 188.

⁴⁹ See Finnemore (fn. 31), 339–42. Note that in IR constructivism, there are conscious attempts to incorporate at least ideational contestation, based on Habermas’s notion of discourse; see Thomas Risse, “Let’s Argue: Communicative Action in World Politics” *International Organization* 54 (Winter 2000).

uncontested and cannot be instrumentalized for other ends. Globally shared professional norms among scientists and engineers surely matter, but we doubt that the resulting prescriptions dominate all other considerations in the day-to-day work of international standardization. At the same time, Loya and Boli have advanced the most explicit theory of institutionalized international standards setting so far, and it surely warrants systematic empirical testing.

REALISM

Realists interested in issues of international cooperation have focused primarily on how anarchy in the international system impedes cooperation among states.⁵⁰ Realists put considerations of power at the center of their analyses and see states as the predominant actors in international politics, to which all other actors are subordinated. Power is usually defined in terms of resources, which are assumed to be highly fungible. Military resources are usually considered dominant, although in international economic affairs power is typically understood in terms of economic resources because the usability of military resources in this realm is limited. Since power resources are assumed to be fungible, changes in a state's material wealth have what Joanne Gowa calls "security externalities":⁵¹ changes in economic resources change the state's potential military resources and hence affect its political power. Consequently, under anarchy, expected unfavorable changes in a state's absolute or relative resources are cause for noncooperation.⁵² Thus, in his study of transatlantic conflict and cooperation over nontariff barriers to trade, Joseph Grieco emphasizes that "a state will . . . limit its commitment to a cooperative arrangement if it believes that . . . otherwise mutually positive gains favor partners."⁵³ Where relative gains do not create deadlock preferences that render cooperation impossible, they will accentuate cooperation problems of a Prisoner's Dilemma type.

Yet, as Stephen Krasner has pointed out in his realist analysis of international telecommunications standardization, problems of international cooperation are often "characterized not by Nash equilibria that

⁵⁰For recent overviews of works in the realist tradition, see Steven Walt, "The Enduring Relevance of the Realist Tradition," in Ira Katznelson and Helen Milner, eds., *Political Science: State of the Discipline* (New York: W. W. Norton, 2002); and Colin Elman and Miriam Fendius Elman, eds., *Progress in International Relations: Appraising the Field* (Cambridge: MIT Press, 2003).

⁵¹Gowa, "Bipolarity, Multipolarity, and Free Trade," *American Political Science Review* 83 (December 1989).

⁵²On relative gains and the fungibility of power, see the debate in David Baldwin, ed., *Neorealism and Neoliberalism: The Contemporary Debate* (New York: Columbia University Press, 1993).

⁵³Grieco, *Cooperation among Nations: Europe, America, and Non-Tariff Barriers to Trade* (Ithaca, N.Y.: Cornell University Press 1990), 10.

are Pareto suboptimal but rather by disagreements over which point along the Pareto frontier should be chosen, that is, by distributional conflicts rather than by market failure.”⁵⁴ In other words, where world society sees a simple coordination game, realists see a “Battle of the Sexes” coordination game along the lines of Figure 3.

First-mover advantage—that is, timely involvement—is crucial in such a game. But what determines first-mover advantage? According to the realist view, involvement in and consequently the outcome of Battle of the Sexes coordination games are functions of the international distribution of power. Realists doubt that institutions (including formal organizations) can constrain power, and hence they consider naïve the liberal view that international institutions serve to improve information flows and knowledge, foster comity of nations, and enhance global welfare. At the same time, Krasner and other realists explicitly recognize that the exercise of power can be facilitated and legitimated through international institutions. Powerful states thus seek to control these institutions to secure favorable distributional outcomes—and often succeed in enriching themselves at the expense of weaker states. Battles over international institutions and over drawing up international rules like standards are therefore proxy battles over distributional outcomes, and only changes in the distribution of power bring about changes in the operation and output of institutional arrangements.⁵⁵

Many of Krasner’s examples refer to the International Telecommunications Union (ITU), a prime example of a traditional intergovernmental institution, where states lobby to get the technical preferences of their firms written into international standards. The ITU, however, is not a typical international SDO. Rather, most international standardization takes place in international nongovernmental technical organizations of which states/governments themselves are not members. Is this an analytical problem for statecentric realist theory? Not necessarily. For example, in his study on setting internet-related standards, Dan Drezner acknowledges that governments have delegated the management of the internet to nonstate actors because these actors possess a comparative advantage in gathering information and harnessing the requisite technical expertise. He argues, however, that the act of delegation in no way diminishes states’ influence over the process and outcome of private rule making. According to Drezner: “States will

⁵⁴ Krasner, “Global Communications and National Power: Life of the Pareto Frontier,” *World Politics* 43 (April 1991).

⁵⁵ *Ibid.*; Krasner (fn. 24); Baldwin (fn. 52); John Mearsheimer, “The False Promise of International Institutions,” *International Security* 19 (Winter 1994–95).

manipulate private forms of authority to achieve their desired ends,” and “the outcome will reflect greater [state] power preferences.” He concludes: “[O]nly by giving the great powers [analytical] pride of place is it possible to ascertain the conditions under which non-state actors will exercise their influence.”⁵⁶ In other words, for realists, the concerns of states about “security externalities” are not limited to interstate commercial relations but extend to transnational private sector collaboration. Big states, in particular, thus have an incentive to intervene in international private sector governance to advance their desired ends.

In sum, applied to international standardization, realism suggests that the economic might of states is the principal force in setting the agenda and determining success in international standards setting—the central dynamic of which is captured by the Battle of the Sexes coordination game. Realism also suggests that OECD countries, especially the United States and Europe, should be the major players in international standardization of manufactured products. Since the aggregate gross national product (GNP) of Europe is almost identical to the GNP of the U.S., the realist approach predicts similar levels of involvement in international standards setting between the two regions. Alternatively, given the primacy of the state over any nonstate entities in realist theory, realists may predict that the U.S.—which unlike Europe combines enormous resources in a single state—is likely to be the dominant voice in international standardization.⁵⁷

Realism clearly corrects one of the key weaknesses of the world society approach—the lack of politics—by putting power and distributional issues front and center. Here, too, however, we have doubts whether this approach captures the central dynamics of international standardization very well. Realists greatly exaggerate the ability of governments to intervene effectively in institutionalized processes where states as such are not recognized as legitimate actors. What is consequently missing from the realist approach to the study of international standards setting is an appreciation of private sector institutional dynamics. Specifically, we need to understand (1) how private sector interests have traditionally been organized and how their domestic institutional arrangements, which may vary greatly, interact with international organizations of standardization; and (2) how differing degrees

⁵⁶ Dan Drezner, “The Global Governance of the Internet: Bringing the State Back,” *Political Science Quarterly* (forthcoming).

⁵⁷ As a further alternative, realism may predict that if existing institutions fail to accommodate the interests of the most powerful actors, those actors will create and privilege rival institutions, leading to the demise of the institutions that fail to adapt to the distribution of power. We address this issue in the conclusion.

of institutional complementarities between domestic and international organizations may affect the ability of actors from a given country to be actively involved in international standardization.

III. THE INSTITUTIONAL COMPLEMENTARITIES APPROACH TO INTERNATIONAL STANDARDIZATION

We offer an alternative analytical approach to the study of institutionalized international standardization, which seeks to correct for the weaknesses of the two previous approaches. We call this the institutional complementarities approach. It posits that, after controlling for other factors that influence involvement in international standardization, differences in institutional complementarities—complementarities of historically conditioned standardization systems at the national level with the institutional structure of standardization at the international level—play a critical though largely accidental role in placing firms from different countries or regions in a first- or second-mover position when standardization becomes global. First movers set the international standards agenda (reaping payoff 4 in the coordination game), and laggards, or second movers, pay the switching costs (thus getting payoff 3). The institutional complementarities approach seeks to answer Martin and Simmons's call for more research on *how* institutions matter in international politics, as well as Krasner's call for a better "understanding of how the players in the game came to exist in the first place."⁵⁸

The institutional complementarities approach accepts two fundamental premises of realism. First, we, too, assume that economic actors behave in a self-interested fashion. Second, we assume that international harmonization—of rules, norms, policies, or practices—involves distributional conflicts because it requires departures from current practice. International harmonization of standards therefore is well captured by the "Battle of the Sexes" coordination game. We agree that significant economic resources and technical expertise—emphasized by realism and the world society approach, respectively—are prerequisites for active participation in international standardization. Unlike these other approaches, however, we posit that such resources are necessary but not sufficient conditions for explaining first-mover advantage in institutionalized international standards setting. What is missing is an appreciation of the central role played by the variation in complementarities between the institutional structure of the international standardization organizations and the institutional structure of *national* standardization

⁵⁸ Martin and Simmons (fn. 7); Krasner (fn. 54), 365.

systems that act as an intermediary between domestic firms and global standards organizations.

To address this weakness, we build on a central insight of the historical institutionalist tradition in comparative politics, namely, that institutions are often created by specific historical events but then become entrenched in self-reinforcing ways, such that the institutions one encounters at a given point in time may be better explained by institutional legacies than by their current functionality.⁵⁹ This idea brings questions of timing and temporality into the analysis of how institutions matter in international politics,⁶⁰ and it suggests that a given standardization system need not constitute an optimal institutional arrangement at a particular point in time.⁶¹

Standardization institutions developed through political contestation between actors who wanted the institutions to serve to advance their interests in a particular context. Due to the historical predominance of domestic economic activity, national systems of standardization in advanced industrialized countries developed and solidified (with entrenched interests privileging a path-dependent evolution) long before institutionalized international cooperation in this realm became a major issue. Based on this historical institutionalist reasoning, we expect differences in domestic institutions to persist even if they vary in complementarity with existing international institutions when cooperation grows at the international level. What are the implications for explaining the process of international standardization?

We define complementarity as a constellation in which the combination of two (or more) elements increases the benefits attained from any of them.⁶² The role that we hypothesize institutional complemen-

⁵⁹ See, e.g., Kathleen Thelen, "Historical Institutionalism in Comparative Politics," *Annual Review of Political Science* 2 (1999); and Paul Pierson, "Increasing Returns, Path Dependence, and the State of Politics," *American Political Science Review* 94 (June 2000).

⁶⁰ Tim Büthe, "Taking Temporality Seriously: Modeling History and the Use of Narratives as Evidence," *American Political Science Review* 96 (September 2002).

⁶¹ The idea also plays an important role in much of the literature on varieties of capitalism and in many second image reversed arguments in international political economy, such as Peter Katzenstein, ed., *Between Power and Plenty: Foreign Economic Policies of Advanced Industrial States* (Madison: University of Wisconsin Press, 1978), esp. 323–32. Recent works in the second image reversed tradition that are related to standardization and/or regulatory issues include Kelly Kollman and Aseem Prakash, "Green by Choice? Cross-National Variations in Firms' Responses to EMS-Based Environmental Regimes," *World Politics* 53 (April 2001); and Abraham Newman and David Bach, "Self-Regulatory Trajectories in the Shadow of Public Power: Resolving Digital Dilemmas in Europe and the United States," *Governance* 17, no. 3 (2004).

⁶² See Martin Höpner, "What Connects Industrial Relations with Corporate Governance? A Review on Complementarity" (Manuscript, Center for European Studies, Harvard University, January 2003); and Peter Hall and David Soskice, eds., *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage* (Oxford: Oxford University Press, 2001), 17. Note that we conceptualize complementarity as being on a continuum.

tarities playing in international cooperation is analytically quite distinct from their role in the comparative political economy literature. That literature mostly invokes the fit between institutions *at one level of aggregation* to explain phenomena that can then be compared across different entities, such as the output performance across firms or economic growth rates across countries.⁶³ International cooperation through non-governmental standardization institutions instead involves institutional variation at one level of aggregation (for example, national-level institutions of structure A and A') in a setting where it is necessary or at least desirable to coordinate policies or practices at a higher level of aggregation, where a single (international) institution B exists. In such a setting, how does the difference in fit—between A and B on the one hand and A' and B on the other—affect the relative ability of actors within A to have a voice vis-à-vis actors within A' (and ideally first-mover advantage) in the specification of the coordinated solution at the international level, given that the institutional structure of B requires actors from within A to act through institutional structure A and actors from within A' to act through A'?⁶⁴

We identify two dimensions along which domestic-level institutions may differ, with important implications for institutional complementarity: (1) the level of consultation or coordination of domestic actors and (2) the level of organizational hierarchy. The former affects the flow of information and the *effectiveness* or quality of national participation at the international level; the latter affects the coherence of representation of national preferences at the international level and thus

⁶³Notions of institutional complementarity were introduced in economics to analyze the fit between organizational structure and work practices within firms, e.g., Alfred Dupont Chandler, *Strategy and Structure* (Cambridge: MIT Press, 1962); Paul Milgrom and John Roberts, "Complementarities and Fit: Strategy, Structure, and Organizational Change in Manufacturing," *Journal of Accounting and Economics* 19 (March–May 1995), 179–208. In comparative political economy, notions of complementarity play an important role of the varieties of capitalism literature, especially Masahiko Aoki, "The Contingent Governance of Teams: Analysis of Institutional Complementarity," *International Economic Review* 33 (August 1994), 657–76; Bruno Amable, Ekkehard Ernst, and Stefano Palombarini, "How Do Financial Markets Affect Industrial Relations? An Institutional Complementarities Approach" (Manuscript, University of Paris, August 2001, <http://pythie.cepremap.ens.fr/~amable/instcomp.pdf>, accessed June 30, 2003); and Peter Hall and Daniel Gingerich, "Varieties of Capitalism and Institutional Complementarities in the Macroeconomy" (Paper presented at the International Seminar on Institutional Complementarities and Dynamics of Economic Systems, Université de Paris, April 5–6, 2002). None of these, however, considers the implications of institutional complementarities for the ability of actors at a lower level to affect coordination efficiently at a higher level of aggregation.

⁶⁴Since national-level SDOs are part and parcel of ISO and IEC, they constitute quite unambiguously a set of institutions "more or less 'naturally' involved with the set of activities directly concerned"; Bruno Amable and Pascal Petit, "Identifying the Structure of Institutions to Promote Innovation and Growth," CEPREMAP Working Papers no. 9919 (Université de Paris, October 1999), 3. We thus use the international institutional structure itself to provide an analytical focus of most pertinent institutional complementarities in the dense web of political-economic social institutions of advanced capitalist democracies.

the ability to be a participant as such. There are good reasons to expect that the two go hand in hand (a coordinated system geared toward producing national consensus standards has an affinity for institutional hierarchy), but it is analytically useful to treat the two dimensions separately. We discuss them in turn.

The level of consultation or coordination of domestic actors can range from low levels in market-based systems of multiple competing domestic standards organizations to high levels in consensus-based systems in which firms and other actors cooperate to establish a single national standard for any given product. Differences along this dimension affect information flow from the top down, that is, the organizational ability of domestic standards institutions to convey expeditiously information about new standards proposals at the international level to the domestic actors most likely to be affected by these proposals. The more a domestic standardization system is based on the principle of market competition, the more will its competing SDOs treat information as a proprietary asset and restrict its dissemination to dues-paying members. By contrast, the more a system is based on consultation and coordination, the more it will have institutionalized information flow (vertically and horizontally), which lowers the transaction costs of information provision. The resulting informational advantage should enable firms operating in such systems to get involved in the technical specification of international standards (via their national standardization organizations) earlier and more frequently than firms operating in systems with low levels of institutionalized coordination among domestic actors on standards issues.

Equally importantly, differences on the first dimension also affect interest aggregation from the bottom up. The more a domestic standardization system is based on principles of coordination, the more it should naturally be geared toward providing opportunities for input from a broad range of interested parties and toward aggregating their diverse preferences into a national consensus standard. This should facilitate a broadly supported national position regarding the technical specification of any *international* standard. Conversely, the more a national system of standardization is characterized by multiple competing SDOs, the more it will lack an institutional mechanism for preference aggregation, impeding the ability of domestic actors to influence international standards efficiently.

The second dimension, that is, the level of organizational hierarchy, affects the ability to project national technical preferences with a single voice onto the international arena. It should be crucial for the ability to

participate—be a player—in the technical specification of international standards through the governance process described in Section I, which is organized on the principle of national representation, supplemented by consensus decision-making procedures.⁶⁵ International harmonization of standards affects a heterogeneous set of interests within each country. Since even firms from within the same industry may differ in their prior practices and anticipated adjustment costs, they may well have divergent preferences. Their simultaneous, additive representation at the international level undermines the country's ability to use the consensus procedures of the international institutions to influence the specification of international standards. By contrast, a high degree of organizational hierarchy in a country's domestic system of standardization, which clearly designates a national representative that can authoritatively speak on behalf of domestic interests, facilitates the ability to speak with a single voice.

In sum, the institutional complementarities approach suggests that domestic standardization systems involving high levels of hierarchy and consultation/coordination facilitate the accommodation of new layers of standardization activity above the national level. Offering greater institutional complementarity with international standards institutions, these organizational characteristics ease the adaptation of national SDOs and their domestic constituencies (firms and other actors interested in standards) to changed circumstances in which economic and political imperatives push toward increasingly setting standards at the international level.⁶⁶ By contrast, systems based on decentralization or institutional "anarchy" and market competition exhibit low complementarity with international standards institutions and impede adaptation.

THE DOMESTIC INSTITUTIONAL VARIABLE:

TWO SYSTEMS OF STANDARDIZATION

To derive specific, empirically observable implications from our argument requires at least cursory knowledge of the actual domestic

⁶⁵ As noted before, the international standardization organizations are *nongovernmental* organizations, whose members are national-level standards organizations, not states/governments.

⁶⁶ Regarding the ability of some types of domestic institutions to provide resources that help actors adopt to change while others inhibit change, see Peter Hall, "The Movement from Keynesianism to Monetarism: Institutional Analysis and British Economic Policy in the 1970s," in Sven Steimo, Kathleen Thelen, and Frank Longstreth, eds., *Structuring Politics: Historical Institutionalism in Comparative Analysis* (New York: Cambridge University Press, 1992). Among the imperatives for international standardization are trade agreements that privilege international standards and the increase in international trade, which has been disproportionately concentrated in manufactured goods; Timothy McKeown, "The Global Economy, Post-Fordism, and Trade Policy in Advanced Industrialized States," in Herbert Kitschelt, Peter Lange, Gary Marks, and John Stephens, eds., *Continuity and Change in Contemporary Capitalism* (New York: Cambridge University Press, 1999).

standardization institutions of the key players in international standardization—the Americans and the Europeans. We therefore sketch in this subsection the main features and institutional differences among national systems of standardization in the U.S. and the major European countries—systems that date back to the nineteenth and the early twentieth century and have changed little since. What emerges from the study of the formal institutions and organizational practices is that there are, broadly speaking, two types of institutional systems at the national level: an American (U.S.) system of standardization, which is fragmented, market driven, and characterized by a high degree of internal competition, and a markedly more hierarchical and highly coordinated system in Europe, which is also publicly regulated and subsidized.⁶⁷ In the preglobalization era these different systems served their domestic economies similarly well.⁶⁸ Globalization, however, has confronted them with a new reality, and the ability to cope with new external challenges and adapt to new circumstances has varied across systems.

THE AMERICAN SYSTEM OF STANDARDIZATION

The U.S. system reflects a strong cultural and political bias in favor of market solutions.⁶⁹ Decentralized and characterized by a high degree of competition among many SDOs, it operates with little government oversight and no public financial support. The U.S. private sector standards community comprises some 300 trade associations, 130 professional and scientific societies, 40 general membership organizations, and approximately 150 consortia, which together have set about 49,000 standards. It includes such influential and internationally respected SDOs as the American Society for Testing and Materials (ASTM), producer of the largest number of nongovernmental voluntary standards in the U.S., the American Society of Mechanical Engineers (ASME), famous for its Boiler and Pressure Vessel Code, and the Institute of Electrical and Electronics Engineers (IEEE), which is responsible for the

⁶⁷This is not to say that the domestic institutions for standardization are identical across Europe; for a rich discussion, see Jay Tate, “National Varieties of Standardization,” in Hall and Soskice (fn. 62), but the difference between the U.S. and the Europeans is much larger than any difference among the Europeans.

⁶⁸We are *not* arguing that any one system is superior in general. As Hendrik Spruyt shows historically, welfare-enhancing standardization does not require a single mode of governance for the standardization process; Spruyt, “The Supply and Demand of Governance in Standard-Setting: Insights from the Past,” *Journal of European Public Policy* 8, no. 3 (2001), 382–83. Similarly, we have found few systematic differences in firms’ assessments of the technical quality of U.S. and European countries’ domestic standards per se.

⁶⁹On this bias, see, for example, David Vogel, *Kindred Strangers: The Uneasy Relationship between Politics and Business in America* (Princeton: Princeton University Press, 1996), esp. 29–72.

National Electrical Safety Code. The sale of standards documents provides 50–80 percent of the income of U.S. SDOs, with the remainder coming mostly from membership fees.

American SDOs have a long tradition of keeping government at arm's length, and attempts at governmental interference in the workings of the private standards system are few. At a 1990 hearing held by the National Institute of Standards and Technology (NIST) to determine whether the federal government should become more active in standards setting, especially in the international arena, the response of those testifying was an emphatic no.⁷⁰

In the absence of government control or any other central monitoring and coordinating agent, the system that emerges is characterized by extreme pluralism. Attempts to inject a measure of unity into the system have largely failed. In the early 1960s Francis LaQue, vice president of the International Nickel Corporation, proposed the creation of a national coordinating institution; this led to the establishment of a private sector organization called the American National Standards Institute (ANSI). Commenting on the system a few years later, the Stanford Research Institute (SRI) observed: "Up to the mid-1960s, a favorable solution appeared possible under the guise of ANSI. . . . Reportedly, however, ANSI now has less support and less probability of succeeding as the nominal national voluntary standards coordinating agency than it did . . . [half] a decade ago. . . . In fact, fragmentation is becoming worse. . . . A leadership conflict exists and will probably persist for some time."⁷¹

This prediction proved correct. Some thirty years later ANSI remains a weak institution. Even though it is formally the sole representative of U.S. interests in international standards organizations, its status has not been fully accepted by major players in the American standards community, and a few organizations continue to act independently of it. Private standards organizations fear that a more centralized system would rob them of their revenues and eclipse their power and autonomy. The result is a "hodgepodge of sources of standards rather than a neat pyramid with ANSI at the apex."⁷² In sum, in the absence of any

⁷⁰ See NIST, *Public Hearing Proceedings: Improving U.S. Participation in International Standards Activities*, cited in U.S. Congress, Office of Technology Assessment, *Global Standards: Building Blocks for the Future* (hereafter cited as *Global Standards Report*), TCT-512 (Washington, D.C.: U.S. Government Printing Office, March 1992), 15. (NIST is an agency of the U.S. Commerce Department's Technology Administration). See also the presentation by James Thomas, president of ASTM, at a 1998 conference entitled, "Toward a National Standards Strategy to Meet Global Needs," in Krista Johnsen Leuteritz and Walter Leight, eds., *Conference Report* (Washington, D.C.: U.S. Department of Commerce, February 1999), 53 (<http://nist.gov/ts/htdocs/210/ir6290.pdf>, accessed June 30, 2003).

⁷¹ SRI, *Industrial Standards* (Menlo Park, Calif.: SRI, Long Range Planning Service, 1971), 3.

⁷² Robert Hamilton, "The Role of Nongovernmental Standards in the Development of Mandatory Federal Standards Affecting Safety or Health," *Texas Law Review* 56 (November 1978), 1343.

other central coordinating agent, U.S. standardization approximates the governance system of anarchy.

THE EUROPEAN SYSTEM OF STANDARDIZATION

In stark contrast to the American system, standardization in European countries is centralized, coordinated, regulated, subsidized, and inclusive. As in the United States, the bulk of industrial activity in Europe is conducted and organized in sectors, and standards experts are organized in private sector bodies. However, unlike their American counterparts, these bodies are not autonomous standardizers but constituent elements of a much larger and hierarchical institutional structure: the country's national standards developing organization, such as DIN, the German Institute for Standardization, or BSI, the British Standards Institution. Each European country thus has one national SDO that adopts technical specifications and represents national interests at the regional and international levels.⁷³

Another distinctive feature of the European system is that most national SDOs are subject to governmental regulation that requires them to have representatives from a wide range of interests on technical committees and to comply with comprehensive rules on public inquiry and publication.⁷⁴ Consequently, European SDOs count among their members not only industry and trade associations and professional and scientific organizations, but also trade unions, consumer groups, various other types of socioeconomic interest groups, ministries, and public agencies. The drafting of standards is done by the technical committees and working groups of the national SDOs comprising experts from a range of interested groups; and adoption of a standard—by consensus—is preceded by circulation of drafts for public comment.⁷⁵ European governments offer generous subsidies to support the standardization work: these subsidies represent on average about 20 percent of the income of national SDOs, with the rest coming from membership fees and the sale of standards and other documents.

The number of national experts involved in standardization at any given time is in the tens of thousands.⁷⁶ Since participation in stand-

⁷³The main national SDO often has a sister organization responsible for electrical and electronic standards.

⁷⁴For details, see Josef Falke and Harm Schepel, eds., *Legal Aspects of Standardisation in the Member States of the EC and of EFTA* (Luxembourg: Office for Official Publications of the European Communities, 2000).

⁷⁵Consensus does not mean unanimous consent but implies that objections have been reconciled, or are not sustained, or are considered to be of such minor significance as not to warrant further delay.

⁷⁶For example, there are about 36,000 for DIN and 20,000 for BSI.

ardization can be quite costly and is nonremunerative, representatives of noncommercial interests may find it difficult to be actively involved. Most American standards organizations contend that willingness to pay is the best measure of interest in the process and see no need for financial assistance. In Europe, by contrast, the need for subsidies to weaker groups is generally accepted and viewed as a prerequisite for genuine openness and due process.

The European system of standardization is characterized not only by a national layer of standards organizations but also by a regional layer created in the course of economic integration. Two major regional standards organizations exist, the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC),⁷⁷ both partially funded by the EU Commission. CEN was established in 1961 as a nonprofit regional association to produce voluntary European standards in a broad range of areas. CENELEC was established in 1972 to produce electrotechnical and electronic engineering standards. The members of CEN and CENELEC are the European national standardization organizations. As part of their close working relationship with CEN/CENELEC, each national standards organization selects up to three experts representing the national technical preferences in a given regional standards committee and establishes a “mirror committee” at the national level to keep all interested domestic parties informed and to decide on a national consensus position.⁷⁸ After the approval of a European standard, national SDOs implement the standard as a national standard, either by publication of identical texts or by endorsement, and conflicting national standards must be withdrawn.

In sum, what emerges in Europe is a picture of hierarchy, with national standards organizations representing a broad-based domestic consensus with a single voice at the regional and international level.

CONSEQUENCES OF DOMESTIC INSTITUTIONAL DIFFERENCES FOR INTERNATIONAL STANDARDIZATION

Given these differences in domestic institutions, what specific outcomes should we expect to observe based on the institutional complementarities approach? U.S.-European institutional differences on the first dimension should affect information flow: not facing any domestic competitor, subsidized European SDOs have little incentive to hold back

⁷⁷The acronyms stand for Comité Européen de Normalisation and Comité Européen de Normalisation Électronique.

⁷⁸CEN, for example, has 274 technical committees handling 8,842 standardization work items.

information. Indeed, to the contrary. Subjected as they are to public scrutiny to justify the subsidies they receive, the European SDOs have strong incentives to legitimate their work through the institutionalized and timely dissemination of information from the central secretariat to industry associations, firms, and other social actors. By contrast, domestic U.S. SDOs, which compete with one another, have strong incentives to guard the information they gather, and their arm's-length relationship with other domestic groups makes the institutionalization of information dissemination less likely.

In addition, nongovernmental national standards monopolies in Europe, such as Germany's DIN or Britain's BSI, are inherently geared toward coordinating a diverse set of actors in order to arrive at one aggregate national position. This national consensus, based on the involvement of a broad range of interests, can then be easily and authoritatively presented at the international level. The process of aggregating technical preferences and projecting consensus standards to a higher level is considerably more difficult in the decentralized and uncoordinated standards system of the U.S., where the nominal national representative for international standardization is a weak and contested institution.

In sum, when standardization becomes an increasingly international process, the organizational characteristics of the European standardization system make for a more felicitous match between the national and international institutions than the characteristics of the largely anarchic American system. Cross-level hierarchies surely mix and match better than do hierarchies and market systems. As a result, we would expect European firms to possess much better information about international standardization opportunities and proposals and, thanks to this informational advantage and more effective interest representation, to be more involved—earlier and more effectively—than their American counterparts.

At the same time, given that we attribute first-mover status largely to institutional embeddedness rather than to national affiliation per se, we should see a notable difference between U.S. firms with subsidiaries in Europe and those without them. As such subsidiaries are treated like European firms in the national and regional standardization processes, they should be able to “play” the standardization game by European rules. For instance, a U.S. multinational with a subsidiary in Germany could send its standards experts via its subsidiary to sit on DIN technical committees and therefore also on CEN committees. By being an integral part of the European structure of standardization, not only would

it receive up-to-date information about standards proposals from European competitors but it would also have privileged access to international standards bodies. As a result, we would more generally expect few differences in involvement at the international level between U.S. firms with subsidiaries in Europe and European firms, whereas we would expect to see marked differences between these two and U.S. firms without subsidiaries.

IV. EXISTING AND ANECDOTAL EMPIRICAL EVIDENCE

What support is there for the three analytical approaches discussed in the two previous sections? Considering the rapidly growing economic and political importance of international standards since the late 1980s, it is surprising and puzzling that no systematic data existed on any aspect of international standardization when this research began. Heretofore, there has been only very limited empirical information, most of it anecdotal, and this sparse evidence suggests that all of the approaches are plausible to some extent.⁷⁹

Much of the existing evidence supports the institutional complementarities approach. The operation of CEN and CENELEC suggests that the institutional characteristics of the European SDOs facilitate accommodating standardization above the national level. And helped by their hierarchical and well-coordinated standardization institutions, Europeans have been able to forge strong institutional links between these regional institutions and the main international standards organizations, established through a series of reciprocity agreements.⁸⁰

⁷⁹In this section we draw primarily on previous work on standardization and on information from sixty-six interviews that we conducted with standards experts mostly between March 1999 and September 2001. We draw to a lesser extent on information relayed to us in response to two open-ended questions, which we posed at the end of our survey to gather more detailed information of the type usually reserved for qualitative interviews.

⁸⁰These are the Vienna Agreement of 1991 between the ISO and CEN, and the Dresden Agreement of 1996 between the IEC and CENELEC (a revision of the Lugano Agreement of 1991). A working agreement also exists between the IEC and the European Telecommunications Standards Institute (ETSI). Under the Vienna Agreement, CEN and ISO have agreed upon detailed procedures for the exchange of information and their cooperation in the drafting and adoption of standards. For example, when a new international standards project is proposed, members in the relevant ISO technical committee decide by majority vote whether CEN or ISO should take the lead in developing the standard. In the vast majority of cases ISO takes the lead, but voting on the final draft standard is parallel with CEN. However, the lead is likely to go to CEN if specific requirements of European directives or regulations must be reflected in a standard, or if the commission mandates that a standard be written by a certain target date, or if the affected businesses are primarily European. Voting on the draft standard takes place in both CEN and ISO. If adopted by both, the European-made standard will become an international standard without further technical discussion at the ISO. The agreement between CENELEC and IEC contains similar provisions; see *Inside the IEC* (Geneva: IEC Central Office, 1990), 22–24. For a detailed recent analysis of EU-level standardization, see Michelle Egan, *Constructing a European Market: Standards, Regulation, and Governance* (New York: Oxford University Press, 2001).

Indications of the relevance of institutional legacies, as emphasized by the institutional complementarities approach, are also provided by many representatives of U.S. firms who noted in interviews that, by the time they learn about the development of a new international standard, it is often too late to affect its technical specification. Moreover, anecdotal evidence suggests that the relative weakness and contestedness of ANSI undermines U.S. interests. Consistent with the institutional complementarities approach, standards experts from the U.S. appear to have no difficulty identifying the central and authoritative interlocutors in European countries, whereas European standards experts frequently point out the near impossibility of finding American interlocutors who can speak authoritatively for the U.S. standards community. This problem has been reported elsewhere too: “[Europeans] complain that one moment they are told that ANSI speaks for all the US, but the next, ASTM is knocking at their doors.”⁸¹

At the same time, some participants and observers of international standardization suggest a more explicitly political view of international standards setting, attributing U.S.-European differences to an aggressive European industrial policy and strategic public financial support of private sector standardizers. This view is well summarized by Raymond Kammer, then director of NIST:

Europe does have a strategy and it is running at full throttle. . . . European governments and industries believe that they can create a competitive advantage in world markets by strongly influencing the content of international standards. NIST’s standards experts in Latin America are reporting that these countries are tending to use European standards, rather than U.S.-developed standards—in part because the European standards bodies make their standards freely available upon request. Because U.S.-based private sector standards developers must recover all their expenses, they must charge for each standard. Other nations do not experience this financial problem to the same extent because their standards bodies receive extensive support from their governments.⁸²

This view supports the realist approach, though it begs the question for realists of why the U.S. is as powerless as Kammer’s statement suggests. Even more supportive of the realist position is other anecdotal evidence, which suggests that American firms, with the help of the U.S. government, can indeed counter European advantages either by building sufficiently large alliances to defeat European schemes or by

⁸¹ *Global Standards Report* (fn. 70), 13.

⁸² Raymond Kammer, statement before the House Committee on Science Subcommittee on Technology, Hearing on International Standards: Technical Barriers to Free Trade, April 28, 1998 (www.house.gov/science/kammer_04-28.htm, accessed June 30, 2003).

threatening retaliation. The following two cases illustrate the plausibility of the power-politics view of standardization.⁸³

In the Safety of Toys case, Europeans managed the ISO toy committee but preferred to conduct most of the technical work, mandated by a Safety of Toys Directive, in the CEN toy committee from which non-Europeans were excluded. In the mid-1990s ANSI protested this exclusion and argued that the standardization work should be brought back to ISO, given the global interest in toy safety. When Europeans resisted this demand, ANSI proceeded to compile a list of non-European countries with significant toy manufacturing and dispatched officials to meet with the leaders of toy associations and national standards bodies in these countries and to encourage them to become members in the ISO toy committee. These efforts paid off; many non-European countries became active committee members and sided with the Americans when the toy committee met in Miami in 1996 and approved a new ISO global standard as a committee item, superseding the draft international standard developed by CEN.

In the second case, the Steel Drum Closures case, direct political pressure and threats forced Europeans to change course and accommodate American interests. In 1990 a CEN technical committee was formed to develop various types of packaging standards, including a standard for steel drum closures. Four years later Rieke Corporation, a U.S. manufacturer of steel drum closures, noticed that the design-based standard being developed by the Europeans would effectively shut its products out of the European market and threaten the viability of the firm. Rieke wrote immediately to its representatives in Congress explaining the potential problem and asking for help. This request led to the involvement of the U.S. Department of Commerce and the U.S. Mission to the European Union in Brussels (facilitated by ANSI). These U.S. government actors warned national standards bodies in Europe that the adoption of the proposed CEN standard would have serious consequences. The extensive lobbying effort paid off: in 1996 Rieke's representative was invited to attend the CEN working group developing the standard for steel drum closures and was allowed to make direct contributions. As a result, CEN developed a broader standard that accommodated Rieke's technical demands.

Yet how representative are these two cases? We have also encountered in our interviews several participants in international standard-

⁸³The examples are drawn from ANSI, *American Access to the European Standardization Process* (New York: American National Standards Institute, 1996), chap. 3.

ization who dismiss such cases as aberrations in what is largely a cooperative and harmonious process. They portray international standardization as driven not by corporate profit motives or by national competition but by a sincere desire of a transnational community of engineers to produce the best technical solution possible to a problem. This view neatly dovetails with the world society approach.

Anecdotal evidence is insightful but inferentially problematic because it is often possible to find examples in support of any number of competing propositions. Because such evidence does not allow us to tell the rule from the exception, a more systematic test of the hypotheses is needed.

V. TESTING CONTENDING THEORIES THROUGH AN INTERNATIONAL STANDARDS SURVEY

In light of the lack of systematic data on standardization, we have designed and implemented an internet-based business survey to build the first comprehensive database that allows the scientific analysis of multiple aspects of international standardization. The survey was launched in September 2001, first in the United States, then in Germany, Spain, Sweden, and the United Kingdom. We selected five economic sectors with important export interests for inclusion in the survey: chemicals, rubber and plastic products, medical devices, petroleum products, and iron and steel products.⁸⁴ Potential participants were selected through compilation of comprehensive lists of the firms in each sector for each country, with the aid of business directories, trade and professional associations, and standards organizations. These lists constituted the sampling frame from which we drew stratified random samples.⁸⁵

⁸⁴The survey was internet based, though paper copies by mail or fax were available for those (few) participants who preferred hard copy. Participants, typically managers or standards experts in firms, were contacted by e-mail or phone and were directed to our website via gateway URLs (www.standards-survey.com or www.standardssurvey.com), equipped with a username and password. Each questionnaire listed thirty-six queries with multiple-answer options and took between fifteen and twenty-five minutes to complete, depending on the extent to which respondents used the write-in options. Translated questionnaires were used in Germany and Spain. By the click of the mouse, the results were electronically transmitted for coding and evaluation. Between September 2001 and May 2002, nearly fourteen hundred questionnaires were collected, about two hundred to three hundred per sector. The response rate was about 32 percent, a rate almost twice as high as most business surveys that do not work with panels of regular participants. No compensation was paid to participants. The convenience of online participation and our use of reminder messages to nonresponding participants appear to have boosted participation, though the promise of a free copy of the final report with executive summary surely also helped.

⁸⁵Stratified random sampling uses one or more characteristics of the units to subdivide the sampling frame into groups, then draws from each group a sample proportional to its share of the total population. Within each group, random selection is used, which justifies the standard assumptions

FINDINGS

Before turning to the analysis of questions designed to test the alternative theoretical approaches, we examine the responses to two questions that provide a sense of the importance of standards for the firms in our sample and their expectations regarding the internationalization of standards setting. We asked respondents to indicate the extent to which they agree or disagree with the following statements:

(1)		disagree or strongly disagree	agree or strongly agree
“Standards have little or no effect on our opportunities to export our products.”	U.S. firms	68%	32%
	European firms	64%	36%
(2)		disagree or strongly disagree	agree or strongly agree
“Standards will increasingly be developed at the international level.”	U.S. firms	12%	88%
	European firms	5%	95%

About two-third majorities of both U.S. and European firms reject the suggestion that standards have little or no effect on their exports, and vast majorities of respondents on both sides of the Atlantic expect standardization to take place increasingly at the international level. These findings suggest that the economic importance of international standardization is comparable for U.S. and European firms. But whose interests shape the technical specifications of the standards that are adopted through the institutionalized process of international standards setting?

We have argued above that a firm must be involved in the process of international standardization to be able to shape the technical content of a given standard. That analytical view of international standardization is strongly supported by our data: 74 percent of American firms and 78 percent of European firms identify getting involved early as important or very important in determining success for the adoption of one’s technical preferences in international standardization.

underpinning statistical inference. We implemented stratified random sampling through making the probability of selection of each firm proportional to its contribution to the total employment in the industry (a variation of what is also known as “dollar sampling”). For a more detailed discussion, see Herbert Weisberg, Jon Krosnick, and Bruce Bowen, *An Introduction to Survey Research, Polling, and Data Analysis*, 3rd ed. (Thousand Oaks, Calif.: Sage, 1996), 38–76; and Sharon Lohr, *Sampling: Design and Analysis* (Pacific Grove, Calif.: Duxbury Press, 1999).

There are various ways in which a firm can get involved in the technical specification of a given standard (see below), but a firm that is *not* involved is unlikely to have much influence in international standardization. A firm's level or frequency of involvement in international standardization thus is a proxy for first- (or second-) mover position and warrants careful analysis. To assess the explanatory power of the different theoretical approaches discussed in Sections II and III, we therefore conduct regression analyses for which our operationalized dependent variable is *Firm Involvement*.⁸⁶

Given that this variable is ordinal, we use ordered logit to estimate two models of involvement. In both models the key independent variable for assessing the impact of cross-regional institutional differences is *Region (Europe)*, a dichotomous variable coded 1 for respondents whose firm is located in Europe and 0 for respondents from firms in the U.S. The world society approach emphasizes harmony and equality, implying comparable levels of involvement; it thus predicts that the coefficient for *Region* should be substantively (and/or statistically) insignificant. Realism also predicts that the coefficient for this variable should be insignificant, though for a different reason, namely, the near parity of the U.S. and EU economies and hence comparable levels of involvement—or that it should be negative, due to U.S. dominance based on U.S. superpower status. The institutional complementarities approach, by contrast, predicts a significant *positive* coefficient for *Region* because Europe's hierarchical and coordinated domestic standardization structures give European firms an informational advantage over American firms and facilitate the aggregation of national technical preferences and their projection to the international level. We thus expect Europeans to be more involved than Americans.

The second independent variable of direct analytical interest is *U.S. Multinational with European Subsidiaries*, coded 1 for U.S. firms with European subsidiaries, 0 otherwise. As elaborated in Section III, the institutional complementarities argument suggests that U.S. multinationals with European subsidiaries may receive information via their subsidiaries and, through these subsidiaries, can also participate in the standardization process *like European firms*. We therefore would expect the coefficient of this variable to be positive and statistically significant.

⁸⁶It is based on the response to the survey question: "When a new international standard has been proposed and is being discussed in the appropriate technical committees/working groups of the international standards developing organization for such standards (ISO, IEC, and so on), [how frequently] does your company try to get involved in the specification of that standard?" The response options are never/rarely (1), sometimes (2), about half of the time (3), often (4), and very often (5).

TABLE 1
FIRM INVOLVEMENT IN TECHNICAL SPECIFICATION OF PROPOSED
INTERNATIONAL STANDARD^a

	<i>Model 1</i>	<i>Model 2</i>
Satisfaction with timeliness of information (about international standards proposals)		0.273*** (0.0636)
Region (Europe)	0.869*** (0.172)	0.809*** (0.173)
U.S. multinational with European subsidiaries	0.554*** (0.146)	0.563*** (0.147)
Size	0.013 (0.0278)	0.0129 (0.0279)
Frequency of divergence (between proposed new international standard and firm's current practice)	0.112* (0.0598)	0.145** (0.0604)
Switching costs	0.414*** (0.0951)	0.461*** (0.096)
SDO committee participation	2.10*** (0.217)	2.07*** (0.218)
Exports as a % of firm's total sales	0.112*** (0.030)	0.109*** (0.0301)
cut 1	3.20 (0.326)	3.40 (0.330)
cut 2	4.68 (0.343)	4.89 (0.347)
cut 3	5.12 (0.347)	5.34 (0.352)
cut 4	6.53 (0.365)	6.77 (0.371)
log likelihood at convergence	-1481.9	-1472.6

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

^aDependent variable: frequency of involvement in international standardization. Ordered logit estimates. Standard errors in parentheses. $N = 1089$. Likelihood ratio test (model 2 vs. model 1): $\chi^2 = 18.55$ ***.

Model 1 (see Table 1) includes these two independent variables along with five control variables. *Size* is an ordinal measure of the size of the firm,⁸⁷ which controls for the greater resources available to larger firms, which therefore, according to the conventional wisdom, often dominate standardization (which would be indicated by a positive coefficient).⁸⁸ Three variables control for the firm's stake in international standardization, based on the economic logic that higher stakes in-

⁸⁷ Respondents selected among seven size categories, ranging from "less than 50" to "more than 1500" employees.

⁸⁸ In addition to anecdotal evidence, there also is a serious theoretical argument developed by Jack Knight that implies that large firms should play a dominant role; Knight, *Institutions and Social Conflict* (Cambridge: Cambridge University Press, 1992).

crease a firm's material incentive to be involved and therefore should increase the frequency of involvement. *Frequency of Divergence* controls for the frequency with which new international standards impose adjustment costs, operationalized as the response to the question: "When a new international standard that applies to your products is proposed, how frequently does that proposed new standard differ from your current practice?"⁸⁹ *Average Switching Costs* controls for the costliness of adjustment, operationalized as the response to the question: "When such a newly proposed international standard differs from your current practice, how costly would it usually be to comply with it if it were adopted as proposed?"⁹⁰ *Exports as a % of Firm's Sales* controls for the extent to which the firm relies upon exports, operationalized as the response to the question: "What percentage of your company's total sales are exports?"⁹¹ For each of the three variables, included to control for stakes in international standardization, economic logic suggests a positive coefficient. Finally, since already having a representative on a technical committee surely increases the likelihood of involvement in the standardization process, *SDO Committee Participation* controls for the respondent firm's representation on domestic, regional, or international technical committees. It is operationalized as the response (Yes/No) to the question: "Do you or other employees of your company (including parent company or subsidiaries abroad) participate in the work of a technical standards committee, subcommittee or working group of a standards developing organization (SDO)?"

The results of the ordered logit estimate for model 1 are reported in the left column of Table 1.⁹² The estimates strongly support our institutional complementarities argument. The coefficients for *Region (Europe)* and *U.S. Multinational with European Subsidiaries* are both positive and statistically highly significant. In addition, the control variables also have the predicted positive coefficients, though *Frequency of Divergence* is statistically significant only at the 0.1 level, and the estimated effect of size is statistically insignificant (see below).

Recall that the institutional complementarities approach suggests several, mutually reinforcing institutional reasons for regional differences in involvement. Specifically, the greater complementarities between European domestic and international standards-setting insti-

⁸⁹ Five response categories, ranging from "rarely" to "very often."

⁹⁰ Four response categories, ranging from "very inexpensive" to "very expensive."

⁹¹ Respondents had to choose among eight response categories, ranging from "0%" to "more than 50%."

⁹² The regressions were estimated in Stata, version 7.

tutions should ensure inter alia that European firms get better and earlier information about relevant international standardization activities. In model 2 we therefore add the variable *Satisfaction with Timeliness of Information* to capture (and directly test) this causal mechanism, which we hypothesized to be driving part of the regional effect in model 1. This variable is operationalized as the response to the question: "How satisfied are you with the timeliness of the information you receive about proposals for new international standards?"⁹³

The estimated coefficient for this variable in model 2 is positive as predicted and highly statistically significant. The coefficient for *Region* is smaller than in model 1, indicating that it had indeed previously picked up part of the effect that is due to differences in information. All the other variables are statistically significant with the predicted sign, except for size, which is now entirely insignificant.⁹⁴ The likelihood ratio tests show that model 2 fits the data significantly better than model 1.

While the statistical significance and signs of the estimated coefficients can be readily interpreted in the ordered logit models in Table 1, the substantive interpretation of the estimated coefficients is not as straightforward as in OLS. To give the reader a sense of the substantive significance of the estimated coefficients from model 2, we report in Table 2 for each of the response categories of the dependent variable the change in the predicted probability of a respondent being in that response category when changing a given independent variable from its minimum to its maximum value, while holding all other variables at their means.⁹⁵

⁹³ Four response categories, ranging from "very dissatisfied" to "very satisfied."

⁹⁴ The insignificance of the *Size* variable is consistent with ISO/IEC standardization being an institutional process of harmonization rather than a market process, but it is nonetheless surprising. Conventional wisdom and anecdotal evidence suggest that large firms in particular try to use the standardization process to get their own, often proprietary technical specifications adopted as the industry standard; see, for example, Marc Austin and Helen Milner, "Strategies of European Standardization," *European Journal of Public Policy* 8, no. 3 (2001). Similarly, one might expect that the current practice of market leaders (which tend to be larger firms) provides a focal point in the standardization process. Interestingly, an ordered logit model of involvement with only firm size as the independent variable produces a positive coefficient that is substantively and statistically highly significant, indicating that larger firms are more likely to be involved in international standardization than smaller ones. However, this positive effect of *Size* evaporates with the inclusion of other independent (control) variables. The insignificance of *Size* persists even when the original seven-category ordinal variable is replaced by dummy variables for each category or by an ordinal variable based on recoding the seven categories into three, four, or five groups. This finding is consistent with views expressed by Hamilton (fn. 72), who questions the conventional wisdom about the dominance of big firms (p. 1381).

⁹⁵ We used the CLARIFY software, which (among other quantities of interest) provides estimates for the change in predicted probabilities (first differences) and confidence intervals around the point estimates, based on Monte Carlo simulations. See Michael Tomz, Gary King, and Jason Wittenberg, *CLARIFY: Software for Interpreting and Presenting Statistical Results*, version 2.1 (May 1, 2003) (<http://gking.harvard.edu>, accessed June 30, 2003). See also King, Tomz, and Wittenberg, "Making the Most of Statistical Analyses," *American Journal of Political Science* 44 (April 2000).

TABLE 2
CHANGE IN THE PROBABILITY OF FIRM INVOLVEMENT IN THE
TECHNICAL SPECIFICATION OF PROPOSED INTERNATIONAL STANDARDS
AT GIVEN LEVEL OF FREQUENCY^a

	<i>Rarely or Never</i>	<i>Sometimes</i>	<i>Half of the Time</i>	<i>Often</i>	<i>Very Often or Always</i>
Satisfaction with information (min → max)	-0.24 (0.06) [-0.34 -0.13]	0.01 (0.01) [-0.006 0.03]	0.04 (0.01) [0.02 0.06]	0.12 (0.03) [0.06 0.17]	0.07 (0.02) [0.04 0.10]
Region (U.S. → Europe)	-0.16 (0.03) [-0.22 -0.1]	-0.02 (0.01) [-0.05 0.004]	0.03 (0.006) [0.02 0.04]	0.10 (0.02) [0.05 0.14]	0.06 (0.02) [0.03 0.09]
U.S. MNC w/European subsidiaries (no → yes)	-0.12 (0.03) [-0.18 -0.06]	-0.007 (0.006) [-0.02 0.002]	0.02 (0.006) [0.01 0.03]	0.07 (0.02) [0.03 0.10]	0.04 (0.01) [0.02 0.06]
Frequency of divergence (min → max)	-0.12 (0.05) [-0.21 -0.02]	-0.009 (0.009) [-0.03 0.002]	0.02 (0.009) [0.0034 0.04]	0.07 (0.03) [0.01 0.13]	0.04 (0.02) [0.006 0.08]
Switching costs (min → max)	-0.30 (0.06) [-0.42 -0.18]	0.02 (0.01) [-0.006 0.04]	0.05 (0.01) [0.03 0.07]	0.15 (0.03) [0.09 0.21]	0.08 (0.02) [0.05 0.12]
SDO committee participation (no → yes)	-0.47 (0.04) [-0.55 -0.38]	0.16 (0.03) [0.10 0.21]	0.07 (0.009) [0.05 0.09]	0.16 (0.01) [0.14 0.19]	0.08 (0.008) [0.06 0.09]
Exports as a % of firm's total sales (min → max)	-0.14 (0.04) [-0.22 -0.06]	-0.0048 (0.006) [-0.02 0.006]	0.02 (0.007) [0.01 0.04]	0.08 (0.02) [0.03 0.12]	0.04 (0.01) [0.02 0.07]

^aColumns represent the five response categories of the dependent variable (frequency of involvement in the technical specification of international standards). Larger bold numbers indicate, based on the estimates from model 2, the change in the probability (that a firm is involved with a given frequency) resulting from switching the independent variable on the left from its minimum to its maximum value while holding all other variables at their means. Standard errors in parentheses; 95 percent confidence intervals in brackets.

The results for the information variable, for instance, indicate that the likelihood of being involved “rarely or never” declines by 24 percent, as the timeliness of information moves from being poor to being very good, whereas the likelihood of being “often” involved increases by 12 percent. Generally, for all the statistically significant independent vari-

ables in model 2, an increase in the independent variable leads to a decline in the probability of being involved at a low frequency and an increase in the probability of being involved at a high frequency.

These findings strongly suggest that the institutional complementarities approach indeed captures the central dynamic of international standards setting better than alternative theoretical approaches. Are there, however, additional testable, observable implications of the theory to increase our confidence in this new approach?

If the institutional complementarities approach is correct, European firms should receive earlier and better information about international standards proposals than U.S. firms. This should be important, since the institutional process of standards setting makes it increasingly difficult to change a proposal as it moves further along in the institutional process. Telling are the cross-regional differences in response to the question: "At what stage do you usually hear about a forthcoming ISO/IEC standard that may affect your products?" As discussed in Section I, there is almost no opportunity to influence the details of a forthcoming standard by the time the institutional process reaches the last, fifth stage. A remarkable 30 percent of American firms learn of new ISO/IEC standards that affect them only during the last stage—compared with a more modest 19 percent of European firms.

Unsurprisingly, a much larger percentage of American firms than European ones report that proposed international standards differ from the firm's current practice, and they end up having to pay high switching costs. We have seen in the Steel Drum Closures case in Section IV that such switching costs can be exorbitant—especially for small firms such as Rieke. Thanks to government intervention at the international level, the Rieke corporation in the Steel Drum Closures case in the end achieved a satisfactory standard, an outcome that seems consistent with realist thinking. But how typical is this case? To find out, we asked survey participants: "When you get involved, *how* do you do so? How frequently do you try to influence the technical specification of a newly proposed international standard by each of the following methods?" Table 3 reports some of the answers by American and European firms.

The results are revealing and show striking differences between the United States and Europe. Contra realism, government plays hardly any supporting role in international standardization; this is particularly clear in the American case. Only 15.1 percent of American firms report contacting Congress often or sometimes, and a mere 9.6 percent of

TABLE 3
FREQUENCY OF USE OF DIFFERENT INFLUENCE METHODS^a

<i>Influence Method</i>	<i>Frequency</i>	<i>United States</i>	<i>Europe</i>
		<i>%</i>	<i>%</i>
We contact our representatives in Congress and ask them to take action on our behalf.	rarely	68.5	
	sometimes	13.2	N/A
	often	1.9	
U.S.: We contact the Dept. of Commerce and ask them to take action on our behalf.	rarely	72.4	63.1
	sometimes	9.4	12.3
	often	0.2	1.7
Europe: We contact our government agency/ministry and ask them to take action on our behalf.	rarely		
	sometimes		
	often		
We ask our national standards organization ^b to get involved on our behalf.	rarely	69.7	42.3
	sometimes	11.8	21.2
	often	3.5	18.1
We contact other national firms in our industry to organize a joint position.	rarely	47.4	36.7
	sometimes	32.2	25.2
	often	9.3	20.4
We contact our subsidiaries abroad and ask them to get involved through their national [and regional] ^c standards organizations. ^d	rarely	34.0	49.1
	sometimes	34.4	24.6
	often	20.4	8.8

^aDifference between the sum of percentages in a given cell and 100 percent is the percentage of respondents who did not make a frequency-of-use selection.

^bANSI for the U.S.

^c"And regional" was added in U.S. survey

^dOnly firms with subsidiaries abroad are taken into account for the reported percentages for this question.

American firms rely on the services of the Department of Commerce with similar frequency.

We noted in the beginning of this section that overwhelming majorities of both U.S. and European firms expect standardization to be conducted increasingly at the international level. Given this information, a final observable implication of the institutional complementarities approach is that U.S. and European firms should differ markedly in their normative assessment of the expected increase in international standards setting. And indeed, asked to indicate the extent to which they agree with the statement that "standards *should* be developed first and foremost at the international level," 83 percent of European firms

but only 43 percent of American firms agreed or strongly agreed. In other words, among Europeans, most respondents expect standardization to move to the international level and an even greater majority believes that such internationalization is a good thing. Among American firms, a similarly large majority expects standardization to move to the international level, but not even half of them welcome it. This finding suggests again that the differences in institutional complementarities highlighted in our analysis result in actually adopted standards more favorable to European firms.

CONCLUSION

We began with two quotes, one suggesting that standardization belongs to the realm of technological rationality and is therefore impervious to economic and political pressures, the other countering that science and rationality are masks hiding unbridled economic ambitions of actors seeking to control the standards agenda for their own benefit. Each of the theoretical perspectives underpinning these quotes illuminates important aspects of international standardization. The world society approach captures a normative element of international standardization. Thus, among engineers and scientists conducting standardization work in technical committees, it is considered unacceptable to demand changes to a proposal simply because its technical specifications deprive their firms of economic benefits. Instead, they must justify their objections in technical terms as attempts to improve the quality of a standard. Realism, in turn, rightly identifies actors from the most economically powerful states as the major players in international standards games.

We have argued, however, that both of these approaches are incomplete and hence do not capture the essence of the bulk of international standardization. Our institutional complementarities approach seeks to remedy these weaknesses by highlighting national institutional legacies and their unanticipated consequences in accounting for present international standards processes and outcomes. For over a century the main site of standardization was the national level. Only in recent years has the globalization of product markets magnified the opportunity cost of incompatible national standards and moved the main site of standardization to the international level. We have argued that some national systems possess organizational modes that easily accommodate the new layer of supranational standardization activity; other systems exhibit low complementarity with international standards institutions. High

institutional complementarities guarantee timely information; broad-based, legitimate, and efficient preference aggregation; and effective representation of the national consensus. All are key advantages in international standardization, which resembles a “Battle of the Sexes” coordination game, where timely and frequent involvement in the institutional process is essential for domestic actors hoping to influence an international standard.

While the institutional complementarities approach was motivated primarily by a desire to gain a better theoretical grasp of the specific empirical phenomenon of international standardization, it suggests some theoretical insights that may apply to institutionalized international cooperation among nonstate actors more generally. Specifically, it suggests that institutions matter for cooperation in such realms because they select who will be recognized or at least privileged as an actor (that is, they affect how some actors come to be players in the game) and because they shape the resources that may be legitimately used in the institutional process, thus bestowing power upon actors. Particularly if interests become entrenched in national-level institutions sequentially prior to the onset of significant international cooperation in a given issue-area, there may be notable differences in institutional complementarities, resulting in cross-national differences in the ease with which domestic actors can influence international decisions. None of this suggests that states could not intervene in such realms of institutionalized international nongovernmental cooperation through the use of traditional means of state power, but it should be expected to be markedly more costly and hence rarer for them to do so than in traditional intergovernmental organizations.

Our empirical analysis, based on an original set of data collected through a large-scale international survey of firms in multiple industries, strongly supports the hypotheses derived from the institutional complementarities approach. We have found that European firms are involved much more frequently than U.S. firms in international standardization institutions and therefore are able to capture more of the gains from coordination. And our analysis strongly suggests that the key reasons for greater European success in international standardization are different institutional legacies at the national level in Europe and the U.S., resulting in cross-regional variation in institutional complementarities when standardization becomes global. Consequently, we find that European firms possess better, more timely information about international standards proposals, are more involved in setting international standards, and so on. We thus find strong support for numerous

observable implications of the institutional complementarities approach, from elements of the causal mechanism to normative assessments of ISO and IEC standardization.

At the same time, our results also suggest several avenues for further research. Our finding that Americans tend to be in a second-mover position more often than Europeans (in the economically important area of international product standards) raises the question: why has the most powerful state in the international system not changed the institutions or created competing institutions more conducive to U.S. interests? Several possible explanations are worth mentioning, though a proper analysis is beyond the scope of this article. First, the logic of network externalities suggests that the opportunity cost of producing to purely national standards (for example, U.S. standards) increases as more countries (and especially large developing countries, such as China and Brazil, that are coveted export markets for American and European producers) switch to ISO standards. This steady conversion to international standards has been fueled by a second, increasingly important development: the hardening of soft international law,⁹⁶ such as the WTO Agreement on Technical Barriers to Trade, which facilitates international legal disputes “with bite” against states using national standards in regulations when international ones exist. Third, the legitimacy that ISO and IEC enjoy as truly international producers of transnational standards may be a source of positive feedback that makes the international institutions resilient to change or competition. This legitimacy, to be sure, is underpinned by interests of constituencies that the international institutions have consciously fostered: ISO, for instance, seeks to enlist members from as many countries as possible, by providing technical training programs for developing countries’ national SDOs, by subsidizing their participation in ISO, and so on. In short, international standardization is a very promising area for the study of institutional change and resilience.

Finally, if the institutional complementarities approach is correct, we might expect not only cross-national or cross-regional differences but also sectoral ones. Especially in the U.S., where firms cannot rely upon a centralized national SDO to provide information and represent a national consensus position at the international level, firms in sectors with well-organized industry associations or a small number of dominant firms may do better in international standardization. This calls for sectoral analyses as an additional avenue for further research.

⁹⁶ See Kenneth Abbott and Duncan Snidal, “Hard and Soft Law in International Governance,” *International Organization* 54 (Summer 2000).

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ABSTRACTS

SETTING INTERNATIONAL STANDARDS

TECHNOLOGICAL RATIONALITY OR PRIMACY OF POWER?

By WALTER MATTLI and TIM BÜTHE

Standards have become one of the most important nontariff barriers to trade, especially national product standards that specify design or performance characteristics of manufactured goods. Divergent national standards often inhibit trade, whereas regional and international standards increasingly serve as instruments of trade liberalization. Consequently, the setting of international standards—seemingly technical and apolitical—is rapidly becoming an issue of economic and political salience. But who sets international standards? Who wins, who loses? This article offers a fresh analytical approach to the study of international standards, which the authors call the institutional complementarities approach. It builds on insights from realism and the “Battle of the Sexes” coordination game but emphasizes complementarities of historically conditioned standardization systems at the national level with the institutional structure of standardization at the international level. It posits that, after controlling for other factors that influence involvement in international standardization, differences in institutional complementarities play a critical though largely accidental role in placing firms from different countries or regions in a first- or second-mover position when standardization becomes global. The authors illustrate the insightfulness of this approach through statistical analyses of the first scientific set of data on standards use and standardization, collected by the authors through an international online survey.