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Industry standards, intellectual property, and innovation: Introduction to the special issue

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This special issue of the *International Journal of Industrial Organization* is focused on the inter-relationship between industry standards, intellectual property (IP) protection, and innovative performance. This relationship is a timely topic. For example, recent reports issued by the National Academies (2013) and the International Telecommunications Union (2014) reflect the growing interest and controversy over the role played – for good or ill – by patents and other types of IP in the operation of de facto and voluntary consensus standards, as well as the effects this interaction has on innovation at the firm, industry, and national levels. The seven articles in this volume add meaningfully to our understanding of these complex issues.

As innovation and the production of intangible assets have become increasing drivers of economic growth and prosperity (Corrado et al. 2009), scholars now widely accept that technology standards can produce both costs and benefits to society. At their best, standards offer a solution to coordination problems, with technology platforms – systems of independently supplied components – providing reduced uncertainty, enhanced interoperability, a mechanism for orderly transition to next-generation platforms, investment opportunities, and a lower cost of innovating (Bresnahan and Greenstein, 1999). At their worst, standards can create barriers to trade and competition, hinder the diffusion of innovations that threaten an entrenched platform, or even facilitate collusion among rival firms. Intellectual property protection can contribute to either end of this spectrum, sometimes helping to deliver benefits from standardization, yet in other situations exacerbating the harms associated with excessive market power.

The articles in this volume help us to better comprehend the complex effects and tradeoffs that standards and IP have upon innovation. Each article focuses on a particular context in which the role of standards, IP, and innovation has been understudied. A common approach among the authors is to focus on a set of institutions – be they organizational forms (such as consortia and patent pools) or rules and regulations (such as government-mandated single standards) – and examine the innovation performance or welfare implications of shifts in these particular circumstances. As such, they collectively offer us an enhanced appreciation of how the institutions under which standards are developed may better deliver the benefits that standards promise as well as how market competition occurs within and alongside them.

In their article, Justus Baron, Yann Ménière, and Tim Pohlmann focus on the innovative performance of consortia formed as sub-groups of the member firms in a standard setting organization (SSO). They theoretically and empirically examine how firms involved in formal standards development – an activity marked by both rivalry and the need for consensus – deal with the challenges of collaborative innovation by forming ad hoc consortia. The article informs an important question: Can consortia mitigate R&D coordination failures in formal standardization by allowing participants to better cooperate? In their model of the standard setting process, two different types of R&D coordination failures can occur – a public goods problem and a rent-seeking problem – depending on the structure of firms' incentives. They show that in this setting, a sub-group of firms (a consortium) can improve R&D coordination at the level of the standard, leading to an increase in innovation if the public good regime is strong, but depressing innovation if rent-seeking dominates. They offer empirical support for their findings by collecting a large panel dataset of firms involved in voluntary standards, and demonstrating that innovation performance differs across standards characterized by these different environments. Consistent with the implications of their model, they show that while innovation tends to increase at the firm level after joining a consortium, being in a rent-seeking regime diminishes this outcome.

Henry Delcamp and Aija Leiponen also study the relationship between consortia formation and firm innovation by empirically examining the coordination of innovation strategies by members of SSOs. Using data on standards–essential patents from 32 consortia in wireless telecommunications, as a quasi-experiment they empirically identify the effects of consortium relationships by exploiting a merger in the network of consortia that exogenously changed consortium connections of the members. Their empirical analysis is noteworthy in that it highlights the impact of the patent holder's position in the consortium network on the likelihood of having its patents cited by other participants in subsequent research. They show that the more central the firm is in the consortium network, the greater the likelihood that its patents will be cited by other firms in subsequent patents that are declared “essential” to the standard. This effect is strongest for consortia more technically allied to the primary standard they study. These findings suggest that consortia may be more productive in invention, may be able to internalize externalities so as to increase incentives to conduct R&D, and may increase efficiency by facilitating SSO interaction and markets. Hypothesizing that consortia may govern how innovation occurs in standardized technologies, they encourage policymakers to consider making consortia more open to market actors and managers to understand the opportunities created by consortia membership in influencing other firms' strategies.

In her article, Nancy Gallini also examines a particular type of organizational relationship that has emerged to solve some of the

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perceived limitations of SSOs: patent pools. Motivated by current anti-trust policy – which focuses on the nature of the relationship between the patents included in the pool – she asks: Does that approach provide an adequate screen for welfare-decreasing patent pools? She applies theory to study private and social returns to patent pools in a particular setting: when owners of IP are both horizontally and vertically related. The horizontal relationship is modeled as at least one pool member owning a competing product, while the vertical relationship is described as ownership of complementary IP. She defines a hybrid relationship of these types as "overlapping ownership" and studies the consequences such relationships among firms have upon strategic and organizational decisions. What are the ramifications of these relationships, first for voluntary consensus standard setting and second on the subsequent decision to form a patent pool? She finds that pools can lower prices through a complements effect and provide greater product variety through a differentiation effect, even when the pool member also offers a competing product to the one chosen in the standard. She shows that consumers are better off, regardless of ownership regime, in new product collaborations not characterized by "overlapping ownership." Her findings have ramifications for anti-trust policy, especially when the aim is to support greater consumer welfare in the context of patent pools and other IP-related agreements.

Luís Cabral and David Salant also investigate what standards policy is appropriate, offering insights on government regulation of standards in the context of evolving technologies. They compare the EU-mandated single standard for second generation (2G) wireless telecommunications with the alternate US approach that allowed for market competition among several competing, incompatible standards. Their model demonstrates that government mandating of a single standard leads to a free-riding problem and reduces marginal incentives to conduct R&D and new innovation, which may in turn reduce consumer and social welfare. Their results suggest that maintaining two standards, while imposing some costs, may be necessary to generate dynamic innovation-related benefits. While their model shows a relatively robust relationship between standardization and innovation incentives, it also demonstrates that the relationship between a mandated standard and consumer welfare depends critically on several parameters, such as the total consumer loss from maintaining multiple standards and the alignment of firms' profits with consumer welfare. As such, their model allows them to specify a set of conditions under which a non-standardization equilibrium leads to both consumers and society being better off.

Anne Layne-Farrar and Gerard Llobet also examine a policy choice, highlighting some of the difficult problems that could arise in practical application of an "incremental value rule" for either selecting technology to include in a standard, or establishing its value ex post. Employing a model that allows for heterogeneity across multiple dimensions, they assess licensing transactions for patents that have been incorporated into industry standards. In so doing, they inform a relevant question: Does an incremental value pricing rule replicate an ex ante efficient (competitive) outcome for the licensing of standard essential patents, and should it be used – as commentators have suggested – by courts to measure whether agreements are fair, reasonable, and non-discriminatory (FRAND)? By expanding a technology's attributes from one to many dimensions, they find that agreement by multiple parties over which one among many "incremental values" is appropriate is difficult, particularly when there are other factors – in addition to cost savings – on which patented technologies are weighed by the parties. In their model, ex ante competition also tends to deselect more versatile technologies, thereby undermining the opportunity to realize some efficiencies. This article informs both the field and policy by highlighting several complex problems and potential drawbacks associated with the incremental value approach.

Joseph Clougherty and Michał Grajek teach us about the relationship of international standards and international trade. Motivated by the need to better understand the implications of worldwide diffusion of standardization on trade, they collect a dataset on trade flows and the nation-by-nation penetration of ISO 9000 standardization in 91 nations from 1995–2005, differentiating among several standards penetration channels: enhanced competitiveness, information-compliance costs, and common language. Noting the challenges that have dogged prior empirical efforts to study this relationship, they overcome endogeneity concerns by using panel data, multilateral resistance, and instrumental variable techniques in gravity-model regressions to show that standardization channels along the common language and enhanced competitiveness dimensions affect bilateral trade. They also show that countries most committed to ISO standardization are the chief trade beneficiaries, while the least-committed countries – often developing and transition economies – face export trade barriers, mainly driven by the cost of ISO compliance.

Finally, Daniel Fehder, Fiona Murray, and Scott Stern empirically examine how intellectual property rights (IPRs) affect a particular type of knowledge platform: scientific journals. They are concerned with the possible impact on the downstream demand for knowledge first disclosed in this format, particularly in fields characterized by knowledge both created by and used across institutions — in this case, industry and university. Recognizing that it is not uncommon for researchers to both publish and patent their discoveries, they work from the notion that this choice allows scientists to influence downstream access. After collecting data across several years on patents and associated papers published in two prominent scientific journals, they use a differences-in-differences estimation that allows them to exploit the delays observed between a journal publication and the granting of the related patent right. While finding a negative relationship between the grant of a patent and demand for published knowledge, they document that this effect is short-lived and ultimately becomes positive. Moreover, they demonstrate that a patent grant on a discovery affects the likelihood that an industry author will cite the discovery more positively than a university author. Additionally, they find evidence of sorting in the way knowledge is used downstream, with university authors more likely to cite university-generated knowledge as opposed to that created in industry. Their results suggest that IPR grants impact not only the quantity of downstream cumulative research but also the organization of downstream projects in terms of their institutional location. Of primary importance, the welfare implications of such matching hinge largely on the channels through which it influences the choices of projects by researchers working in different institutional settings.

This last article highlights a core theme of the special issue: namely, that institutions adapt in a variety of complex ways to changes in the intellectual property environment. While their study examines how IP influences the division of labor between academic and commercial scientists, the other articles in this special issue highlight the role of patent pools, consortia and IPR policies as alternative forms of institutional innovation to address IPR challenges that arise in the context of industry standards development. While the contributions to this special issue touch upon many aspects of innovation in the context of industry standards and IP protection, they necessarily pass over many others. We encourage the scholarly community to continue in the tradition of these authors, conducting research that both informs the field and sets the stage for policy making.

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