The Pros and Cons of Standard Setting

Konkurrensverket
Swedish Competition Authority

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Preface

"The Pros and Cons of Standard Setting" is the ninth in the Swedish Competition Authority's Pros and Cons series. This volume collects the five papers that formed the base of an inspiring and well-attended conference, which was held in Stockholm on November 12. Authors from around the world presented their work and senior officials from competition authorities acted as discussants. The lively debate and many appreciative comments I heard at the conference is testimony of the high professional standard of the contributions and of their relevance and timeliness for competition policy.

I would like to express my sincere gratitude to all contributing authors, to the discussants and to the moderator of the conference, Svend Albaek. At the Swedish Competition Authority, Arvid Fredenberg has managed the project and acted as editor together with Sten Nyberg; they both deserve due credit. The same goes for Bengt Kopp and Saba Zarrani, who assisted with the organization of the conference and in producing this conference volume.

Stockholm, November 2010

Dan Sjöblom
Director-General

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She is leading a research project in the Next Generation Infrastructures program (e.g. about the rise of Inverse Infrastructures); has participated in Dutch Science Foundation projects (e.g. standardization and innovation); has worked as a consultant for industry and standards bodies; and has done several policy studies for Dutch ministries (e.g. trends in standardization). She has participated in several European projects (e.g. EU ICT standardization policy). In 2008 she co-edited a book on 'The dynamics of standards' based on a workpackage she led for the European NO-REST project and on a project she did for Sun Microsystems. More recent, she finalised the simulation exercise 'Setting Standards' together with United Knowledge, which has been used successfully by NIST with US policy makers and by the Dutch standards body NEN with Chinese standardization officers.

In the past she coordinated the department's Infrastructure Research program, organized and chaired EURAS conferences and ICES workshops, chaired IEEE standardization conferences and program committees, and organized many sessions and conference tracks. She has published widely and edited special issues, conference proceedings and books. She is e.g. associate editor of the International Journal of IT Standards and Standardization Research (IGI Global). She was nominated for Ada Lovelace Day 2010.

Anne Layne-Farrar is a Director with LECG, LLC. She specializes in competition policy and intellectual property matters, especially where the two issues are combined. She also advises clients on regulation and policy issues across a broad range of industries, with

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Dr. Layne-Farrar received her BA in economics with honors, summa cum laude, from Indiana University (Bloomington), her master's and her PhD in economics from the University of Chicago. She regularly publishes articles in magazines, such as *Antitrust*, *Global Competition Review*, and *Regulation* and in academic journals, including *Antitrust Law Journal*, *International Journal of Industrial Organization*, and *Journal of Competition Law and Economics*.

Klaus Schmidt is Professor of Economics at the University of Munich since 1995. He holds the chair for economic theory and is research professor since 2007. In his research he focuses on contract theory and game theory with applications to competition policy, industrial organisation, auctions and procurement, venture capital, political economy and behavioral and experimental economics. His work has been published in journals such as the American Economic Review, Econometrica, the Journal of Finance, the Quarterly Journal of Economics, the RAND Journal of Economics, and the Review of Economic Studies.

Klaus Schmidt received his Ph.D. in economics from the University of Bonn and the London School of Economics within the European Doctoral Program in 1991. He has been a visiting professor at MIT, Stanford University, Yale University and the University of California at Berkeley. He has been editor of the European Economic Review (1999-2002) and associate editor of the RAND Journal (1995-2008), the Review of Economics Studies (1993-2002), and the Journal of the European Economic Association (2004-). In 2001 he was awarded the "Gossen-Prize" of the German Economic Association and the "Research Prize" of the Berlin-Brandenburg Academy of

Sciences. Klaus Schmidt is a fellow of the European Economic Association (since 2008) and of the Berlin-Brandenburg Academy of Sciences (since 2005). He serves as a member of the Economic Advisory Group on Competition Policy at the European Commission.

Richard Gilbert is Emeritus Professor of Economics and Professor of the Graduate School at the University of California at Berkeley. He was Chair of the Department of Economics at Berkeley from 2002 to 2005 and is currently Chair of the Berkeley Competition Policy Center. From 1993 to 1995 he was Deputy Assistant Attorney General in the Antitrust Division of the U.S. Department of Justice, where he led the effort that developed joint Department of Justice and Federal Trade Commission *Antitrust Guidelines for the Licensing of Intellectual Property*. Before serving in the Department of Justice, Professor Gilbert was the director of the University of California Energy Institute and Associate Editor of The Journal of Industrial Economics, The Journal of Economic Theory, and The Review of Industrial Organization. He is a past president of the Industrial Organization Society. Professor Gilbert's research specialties are in the areas of antitrust economics, intellectual property, research and development, and energy markets. Professor Gilbert holds a Ph.D. in Engineering-Economic Systems from Stanford University and Bachelor of Science and Master of Science degrees in Electrical Engineering from Cornell University.

Damien Geradin is a partner in the Brussels office of the international law firm Howrey LLP where he practices antitrust law with a particular focus on the high technology sector. He has been involved in a variety of high profile cases involving large US technology companies, including *Microsoft* and *Qualcomm*.

He is also a Professor of Competition Law and Economics at the Tilburg University (The Netherlands), a Global Law Professor at the University of Michigan Law School, and a Visiting Professor at the College of Europe in Bruges. He also held visiting Professorships at

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He is the co-editor-in-chief of the Journal of Competition Law and Economics (Oxford University Press). He has published more than 60 legal and economic papers in a variety of academic journals, including the Antitrust Law Journal, the Common Market Law Review, the European Law Review, the Journal of Competition Law and Economics, the European Competition Journal, the Berkeley Technology Law Journal, the Columbia Journal of European Law, the Journal of World Trade, the Journal of International Economic Law, the European Foreign Affairs Review, and the Utilities Law Review.

Damien Geradin is the co-author (with Professor Einer Elhauge) of a leading antitrust casebook: Global Antitrust Law and Economics (Foundation Press, 2007). He is also the co-author (with Michel Kerf) of Controlling Market Power in Telecommunications: Antitrust vs. Sector-specific Regulation (Oxford University Press, 2003).

He is a magna cum laude graduate of the University of Liège School and holds a LL.M. from King's College London and a PhD from Cambridge University.

1 Introduction

Arvid Fredenberg

Standard setting has become an area of disputes where firms view the same set of facts very differently depending on their incentives. Designing adequate competition rules that in an easy way handles these issues is hard. Competition authorities are thus helped by a deeper knowledge of the incentive structures in standards setting organisations. This volume is devoted to exploring the pros and cons of standard setting.

In the first contribution, **Tineke M. Egyedi** from Delft University of Technology starts with illustrating the problem of lack of standards by referring to mobile phone chargers. She then guides us through a case of two competing standards issued by the same standard setting organization. Her conclusion is that "*the implications of competing standards within the same standards body are, for example, an opaque market, uncertainty and hold-ups, incompatibility, inefficiency, duplicate efforts, waste of re-sourcees, slow down of innovation, and in the document format case: protracted vendor-lock-in, uncertainty about the sustainability of digital documents, and most likely a slackening of and higher costs for e-government development.*"

Anne Layne-Farrar from LECG takes us through the change in invention. From being done by large vertically integrated firms, invention is now done by a multitude of firms, with different business models. Depending on the business model of the firm, firms have different incentives and different views on e.g. the appropriate royalty rate. She stresses that "*understanding the origins of the disputes that can arise within cooperative standard setting is a crucial step in finding ways to resolve them.*" She then urges competition authorities to focus on the alleged anticompetitive conduct rather than the business model of the accused.

In the third contribution, **Klaus M. Schmidt** from University of Munich, explains the complements problem that arises when input goods are perfect substitutes and offered by monopolies. When it comes to standards the complements problem arises since standards are based on patents. He continues by showing how patent pools can solve the problem. His suggestion to competition authorities is to "*not only tolerate patent pools but actively encourage them, provided that pools allow for independent licensing outside the pool and require grant-backs. These safeguard are necessary to make sure that the pool is not used to suppress competition between patents that are substitutes and that follow-up innovations cannot be used to block the pool. With these safe-guards in place there is little risk that patent pools are anti-competitive*."

Richard J. Gilbert of the University of California at Berkeley searches for the meaning of fair, reasonable, and non-discriminatory (FRAND) royalties. He suggests a shift in focus from discussing what fair and reasonable means to a workable application of the non-discriminatory component of FRAND. He proposes that "*a reasonable interpretation of the non-discrimination requirement of FRAND is that all licensees should be able to choose from the same schedule of royalties, which may be a single fixed fee, a fixed per-unit running royalty, or a royalty that declines with output*."

In the final contribution, **Damien Geradin** of Tilburg University and Howrey LLP starts with asking: Is there a competition problem or is it just that different members of a standard setting organization have different interests? He then examines the literature on patent hold-up and concludes that the risks have been exaggerated. His conclusion is that "*in the absence of an exclusionary behavior, EU competition law is not the right instrument to address hold up cases allegedly committed by essential patent holders. The Commission and other antitrust authorities are simply poorly equipped to act as price regulators and they should thus not engage in such direction*."

Taken together, the five contributions shed light on the issue of the pros and cons of standard setting. Hopefully, this volume contributes towards a better understanding of the mechanisms through which the rules governing such competition has an impact on

markets – and towards a more effective enforcement of the competition rules.

2 On the Implications of Competing Standards

Tineke M. Egyedi[*]

Currently many people are familiar with the problem that each mobile phone has its own charger. Even chargers from the same supplier are not necessarily interchangeable. In 2008 an estimated 1.2 billion mobile phones were sold worldwide with as many chargers. At least half of them were replacements of 'old' phones. That year at least 51,000 ton of chargers were discarded. (Egyedi & Muto, 2010, p. 9).

Called to action by the European Parliament, the European Commissioner for Enterprise and Industry, Günter Verheugen, threatened in February 2009 with regulatory measures if the mobile phone industry would not come up with a common standard for charger plugs. Soon after the Commission and the industry signed a Memorandum of Understanding. The micro-USB was chosen as the standard.

Verheugen's intervention was widely acclaimed, also by industry (UNEP, 2009). The benefits of a common standard were clear: it would convenience consumers, benefit the environment and help industry to meet the requirements of the European Directive for Electronic Waste (WEEE).[1] Why, then, did the industry not standardize earlier? The most compelling reason[2] was that the market for

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[*] Delft University of Technology. I very much thank my discussant at the Pros and Cons of Setting Standards seminar, Jörg Nothdurft, for his comments on a previous version of this chapter.

[1] http://www.gsmworld.com/newsroom/press-releases/2009/2548.htm

[2] See Egyedi & Muto (2010) for a more elaborate analysis of the case.

(replace) chargers and other accessories, which depended on company- and product-specific interfaces, was too profitable to give up (Meyer, 2007). At stake was a typical case of market failure.[3] Government intervention was required to break open the profitable, but for the environment perverse, business cycle and instigate concerted action.

In a sense, the level of support for Verheugen's action is remarkable because this kind of market failure – i.e., one that is closely intertwined with lack of standardization – occurs more often. Moreover, DG Enterprise is generally very hesitant to interfere. But in this case market failure was recognized and acted upon.

Apart from the question why market failure was recognised in this case, the example of the mobile phone charger plugs raises a more general issue, i.e. the need for governments, industry and the public to be more aware of the negative consequences of lack of standardization.

Overall, economists are prone to point out the tension between the market competition and innovation, on the one hand, and committee standardization, on the other. While on the surface they may seem contradictory, studies on the economics of standardization point out that they are "inextricably linked"(Swann, 2010, p. 9). Standardization limits user options and opens up opportunities. In the case of compatibility standards,[4] on which this chapter focuses, standards provide a platform or 'infrastructure' (Swann, 2010, p. 9) to compete and innovate upon. The resulting level playing field lowers the threshold for new producers, and leads to a better price-

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[3] Market failure is a situation in which the market fails to allocate resources efficiently if left on its own (Mankiw, 2009, p. 11) .

[4] Compatibility refers to 'the suitability of products, processes or services for use together (…).' (ISO/IEC, 1991, 2.2). , Compatibility standards are also referred to as interoperability or interface standards.

performance ratio and larger variety of products for consumers. Indeed, the desired economic effect of committee standards is to support 'full competition in the marketplace for suppliers of a technology and related products and services' (Ghosh, 2005).

This chapter focuses on the consequences of lack of coordinated committee standardization. Lack of committee standardization occurs to different degrees. On the one end of the spectre we have the example of the many different chargers plugs. Sometimes there is much less variety in the market and only a few or two dominant technical alternatives exist, as in the case of the Blu-ray and HD-DVD. On the other end of the spectrum, we have overlapping, competing technical specifications that have been standardized by the same standards committee.[5] Having two largely overlapping standards for the same purpose must be puzzling to outsiders, who might intuitively reason that there can be only one standard. Two standards would be like issuing two competing regulations, one for driving on the right hand side and one for driving on the left side of the road.

Having two largely overlapping standards for the same purpose is in this chapter taken to entail lack of committee standardization, albeit of a totally different degree than in the example of the mobile chargers. It is located at the other extreme of the spectre of lack of standardization, and is therefore an interesting starting point for further exploring the implications of lack of standardization.

In the next sections, to start with, the notions of 'committee standard' and de facto standard are discussed (section 2.1). Much economic literature addresses de facto standard wars. Section 2.2 examines whether these insights also throw light on the dynamics and impact of wars between committee standards. To illustrate the

[5] Or in committees of different standards bodies (Dranove&Gandal, 2003; Lee & Oh, 2006), which can more easily be explained by the different constituents of standards bodies and the Not-Invented-Here syndrome.

value and difficulties of comparing the two, the war on document formats (OOXML and ODF) is discussed, a committee standards war that has raised unusually high interest (e.g. demonstrations in the streets of Oslo and protest songs on YouTube). The implications of lack of standardisation in this case are discussed (section 2.3). The chapter closes by re-addressing the link between market failure and lack of standardisation, and making research recommendations.

2.1 De Facto and Committee Standards

Several salient standards wars have taken place in the past. To name a few, the battle between Alternating Current and Direct Current (McNichol, 2006), the Qwerty vs. Dvorak keyboard layout (David, 1985); the competing video recording systems (Betamax, VHS, Video2000); HiperLANvs. IEEE 802.11 wireless LAN (Jakobs, 2008); Dutch e-purse systems of Chipknip vs. Chipper (deVries, 2006); and W-CDMA vs. CDMA 2000 in mobile telecommunications (Grindley, Salant, & Waverman, 1999). On the surface these battles seem very similar. They involve rival technologies. But some of these standards battles concern products and take place in the market, while others concern negotiated agreements and take place in and between standards committees (Besen, 1991). The former battles are instances of de facto standardization, while the latter concern committee standardization.

D*e facto* standards are widely adopted – specifications or company standards that underlie – products, services, and practices. Because they have a significant market share, the underlying technical specifications become a point of reference for other market players: their specifications are referred and built to by other parties.

Whilst the term 'de facto standardization' may suggest otherwise, only with hindsight can the process be distinguished from other competitive market processes. Only when the process results in a significant market share does the product specification become a 'de facto' standard. Before that it is just market competition. There-

fore, a more exact formulation for de facto standards wars between e.g. products would be: 'product or technology wars'. This also means that there is no principled difference between a 'de facto' standard that emerges from competition between two technologies (e.g. AC/DC) and one that emerges as one out of many technologies (e.g. multiple plug-socket varieties).

Committee standardization[6] differs significantly from de facto standardization. The aim of committee standards is always to reduce needless and unhelpful variety and agree on a specification that can serve as a shared point of reference. The ultimate benefit of having a shared committee standard can be manifold. For example, compatibility standards may ease the development of new and complementary markets; increase standards-based competition and thus help avoid consumer lock-in; and facilitate trade because the referenced standard clarifies what is negotiated about (i.e., the information reduces transaction costs and corrects adverse selection).[7]

The committee may belong to a formal standards body such as the International Organization of Standardization (ISO), to a standards consortium (e.g. OASIS, Ecma International, the World Wide Web Consortium W3C), an industry consortium or a professional organization (e.g. Institute of Electrical and Electronics Engineers,

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[6] A committee standard is a document established by consensus that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context (based on ISO/IEC, 2004, p. 8).

[7] Adverse selection takes place if a supplier of inferior products gains market shares through price competition because the supplier of high quality products has no means to signal the superior quality of its products to consumers. Quality standards support the latter in signaling activities, foster the co-existence of low and high quality market segments, and therefore minimize the likelihood that consumer selection is based on wrong assumptions.

IEEE). Committee standards are usually meant for voluntary use.[8] But in some cases, like the IEC standard voltages they are referred to in regulation and are termed de jure standards. De jure standards are treated here as special cases of committee standards.

Exceptions aside (e.g., Blind, 2008; Gauch, 2008), little has been written about the impact of competing committee standards. Most economic analyses focus on 'de facto' standards wars (Stango, 2004). There is no denying that, depending on the research question, literature based on de facto standards can be useful to understand committee standardization. For example, companies may use similar strategies to compete in markets as they would use in and between standards committees (e.g. product pre-announcements). However, the theoretical findings about de facto standards are possibly too easily generalized to the field of committee standardization. For, while committee standards and de facto standards have in common that they function as points of reference, where standards wars are concerned the difference between a collective agreement (committee standard) and a dominant product (de facto standard) is likely to be significant – if only because the intention of committee standards (e.g. variety reduction, compatibility, avoidance of vendor lock-in) differ from those of de facto standards.

2.2 Dynamics of Standards Wars

The type of standard war focused on is one where rival technologies or specifications are incompatible (Shapiro & Varian, 1999, p. 262). This is a defining factor in its dynamics. A second, related defining factor, in particular for wars involving network technologies like power networks and telecommunications, is the role of 'network

[8] I will not be addressing standards developed by government committees and which are more likely to become mandatory through regulation.

externalities' of the rival technologies.[9] This term refers to an increase in value of the network with every new connected network user (Farrell & Saloner, 1985; Katz & Shapiro, 1985). There are *direct* network externalities: e.g. every new fax machine increases the reach of network; and *indirect* network externalities: e.g. if everyone buys the same car brand, the number of dealers and the availability of spare parts will be higher. Network externalities require compatibility. The absence thereof, as is the case with incompatible rival technologies, reduces the externalities of the involved networks. Although such wars need not necessarily end up in a 'winner-takes-all' situation - Singh & Dahlin (2009) argue that under certain circumstances there may be room for two standards and/or a niche standard - the impact can be far-reaching. If a 'winner' nonetheless emerges, this need not be due to its alleged 'technical superiority'. For example, the 'winning' Qwerty keyboard was not most suited for speed typing, according to David (1985). Nor was the VHS video recorder the most advanced technologically, according to proponents of Philips' Video 2000. Economists have been discussing whether there are ways to minimize the risk that consumers prematurely get locked into a technology of which the quality is not yet evident. Such uncertainty would seem to favour 'delaying the market from committing' and call for a prolongation of standards competition until the technologies have taken shape (Blind, 2008). However, this would also prolong the period of market uncertainty and further

[9] Externalities are the costs or benefits of a transaction incurred or received by members of society but not taken into account by the parties to the transaction. Externalities disappear when they are included in the cost estimate and become internalized. Externalities can be negative, e.g. the polluting industry bringing down the value of houses in the area, or positive, e.g. a well-maintained park increasing the value of houses in the neighborhood. (Lipsey& Steiner, 1979)

drain the resources of the rivals in order to be able to continue the war.

The uncertain outcome of wars between rival revolutions is a key intermediate factor in determining their impact. It undermines competition (Farrell & Saloner, 1986) and leads to a hold–up of investments (Williamson, 1979): producers will try to postpone investments for fear of investing in a 'losing' system and having to write off sunk costs (i.e., costs that are specific and irreversible, and therefore cannot be retrieved). The same hesitations exist on the side of consumers. They will postpone their purchases. The market will stagnate. An example is the recent war between Blu-ray and HD-DVD. The market for High Density DVDs stagnated because consumers feared to be left with a 'losing' system and therefore postponed their purchases.

If there is no clear 'winner' in a standards war incompatibility between the rival technologies will lead to market fragmentation. In the consumer electronics market, for example, "[t]here's no denying that consumer electronics format wars are a nuisance. The rules of engagement are particularly cruel for the buying public, asking them to make an expensive bet on a technology that could be obsolete in a few years time. They emerge with remarkable frequency: 78 rpm discs versus 45 rpm in the 1940s, 8-track versus cassette in the 70s, Betamax versus VHS in the 80s, digital audio tape versus the compact disc in the 90s. Not to mention, of course, the ongoing QuickTime versus Windows Media versus RealMedia struggle"(Warner, 2008)

Similarly rival committee standards will lead to fragmentation – or higher transaction costs if both rivals are to be supported. For example, different standards in pallet size increase the transaction costs of exporters. It forces traders to carry a stock of pallets of different sizes, which poses a particular problem for the developing countries where there is neither a rental market, nor an exchange market for pallets (Raballand & Aldaz-Carroll, 2007).

To overcome the problem of incompatibility between rivals in areas such as ICT and consumer electronics, converters plug-ins,

bridges, multi-protocol stacks etc. are seen by some as relative easy solutions (e.g., Farrell & Saloner, 1992). However, such solutions increase system vulnerability and heighten the costs of production and purchase. They often lead to performance degradation (Shapiro & Varian, 1999), as, for example, conversions between document formats show (Langer, 2008). Another solution is multiprotocol implementation, that is, when competing standards are implemented in single devices (Gauch, 2008). Producers and users of one standard then still have access to the market segment of the competing standard and its externalities. These solutions reduce consumer fears that the market will tip towards the competing standard leaving them with an obsolete technology. However, they also sustain market competition and fragmentation. Since they allow consumers to benefit from the externalities of both markets, there is no urgent need to integrate standards and markets (e.g. DVD recordables; Gauch, 2008). A similar phenomenon is at hand with the dual stack implementation of IPv4 and IPv6 (Vrancken, Kaart, & Soares, 2008). Although aimed to ease migration from IPv4 to IPv6, the dual stack simultaneously lessens the need to migrate because it allows co-existence.

Although more systematic research is needed, the above literature indicates that standards wars

- need not necessarily lead to 'superior' outcomes;
- increase transaction costs and hinder trade, since having two points of reference makes the market less transparent;
- create uncertainty and are more likely to lead to hold-ups, slow down market development, and thus hinder innovation;
- lead to market fragmentation; converters and other attempts to overcome fragmentation involve extra costs. They may offer a partial or temporary solution but are likely to sustain competition, prolong lock-in, and thus reinforce market fragmentation.

To a large extent, insights into the consequences of de facto standards also shed light on those of rival committee standards. However, since committee standards are in effect negotiated agreements, the comparison with de facto standards is necessarily restricted. Different from de facto standardization, committee standardization is about reducing needless variety and creating compatibility. Developing a second standard with an overlapping technical scope runs counter to the advantage of having a single point of reference. Indeed, international standards bodies such as the International Organization for Standardization (ISO) and International Electrotechnical Committee (IEC) would typically reject such new work item proposals.[10]

2.3 Standards War between ODF and OOXML[11]

In 2008 the Joint Technical Committee of ISO/IEC that focuses on IT standardization, JTC 1 in short, accepted a second standard for document formats (Office Open XML, ISO/IEC 29500). This OOXML standard was based on specifications from Microsoft. It was accepted despite the finalization of a very similar standard for document formats two years before: the Open Document Format (ODF, ISO/IEC 26300). The OOXML technology did not substantially differ from the ODF technology. It addressed the same problem – which would have been reason for e.g. Institute of Electrical and Electronic Engineers (IEEE) not to go ahead with standardisation[12].

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[10] See par. 1.3.1, 1.16.1, B.4.2.1, C.4.6.2 in ISO/IEC Directives (ISO/IEC, 2008).

[11] This section is a revision of but draws heavily on the case study description in Egyedi & Koppenhol (2010).

[12] In the IEEE 802 committee, for example, each authorized project must have a distinct identity, be substantially different from other standards, and

2.3.1 Rival Technologies

The Open Document Format (ODF) standards effort aims to store in XML[13] the digital documents made with word processors, spread sheet, or presentation software. The advantage of doing so is that this makes the documents independent of the software used to create them. For example, if software A and software B both use the same document format Y to write and read electronic documents, it becomes much easier for users to switch to the other software provider and for users of different software programmes to exchange documents. ODF explicitly supports supplier independence[14]. Moreover, an important side-effect of encoding documents conformant to an open, public standard is that it allows one to retrieve their content irrespective of possible future changes to the software –proprietary or otherwise. If access to 'old' document content depends on whether or not a commercial software provider upholds backward compatibility, this provider in practice 'owns' the data. A standards-based vendor-neutral IT-environment helps to secure the future accessibility of digital content (property documents and cultural heritage included). This is referred to as *digital sustainability*. Applying XML in software products thus increases the digital sustainability of electronic documents.

Supplier-independence of consumers is especially important in the case of *civil ICT standards* (Andy Updegrove), that is, for stand-

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offer one unique solution per problem, not two (private communication, Vic Hayes, 15 September, 2010)

[13] '[XML] markup encodes a description of the document's storage layout and logical structure.' (chapter 1, W3C, 2006) Nowadays XML is used for very different purposes such as electronic invoicing and publication processes.

[14] http://www.oasis-open.org/committees/office/charter.php

ards that affect information exchange between government and citizens (e.g. e-government services). In such situations the government will not want bias the market by prescribing certain software.

Microsoft's argument to initiate a second XML-based standard very similar to ODF in JTC1 was that the legacy of existing Microsoft Office documents had not sufficiently been taken into account by ODF. OOXML was '[to be] fully compatible with the existing corpus of Microsoft Office documents' (ECMA-376 Part 1, Introduction, p. X). (I will not go into the (de)merits of this argument or what ensued[15], for it has no direct bearing on the principle implications of having competing committee standards. However, whereas competetion between two standards processes could be assumed to give an extra quality impulse to those working on OOXML, such an effect was not observable[16].) Eventually, the OOXML standard was approved as ISO/IEC 29500 in November 2008.

2.3.2 Implications of Competing Committee Standards

The principle of document formats is not easy to understand for a layperson. Having two standards in this area makes it worse. Figure

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[15] For those interested in the highly criticized OOXML standards process in JTC1 I refer to Egyedi & Koppenhol (2010). Of interest is also the blog of Alex Brown, who chaired the decisive international JTC1 meeting in 2008 (http://www.adjb.net/post/Microsoft-Fails-the-Standards-Test.aspx); and Microsoft' s current willingness to actively support the rival ODF standard (http://www.microsoft.com/presspass/press/2008/dec08/12-16implementationnotespr.mspx).

[16] Ibid. More than a thousand serious comments on the OOXML standard had to be dealt with during a key JTC1 meeting. In the end, neither Microsoft nor others have as yet fully implemented the final JTC1 OOXML standard.

1 illustrates the problem in a simplified way. If there were only one standard Y and the two hypothetical software suppliers A and B would adopt it, the documents that compliant to document format Y would be readable and processable irrespective of the software supplier. However, if document format Z were also standardized, each software supplier would need to include a plug-in to access (read) and write differently formatted documents or a document converter. As noted earlier, solutions such as converters and plug-ins come with costs (i.e., require resources and some loss of information).

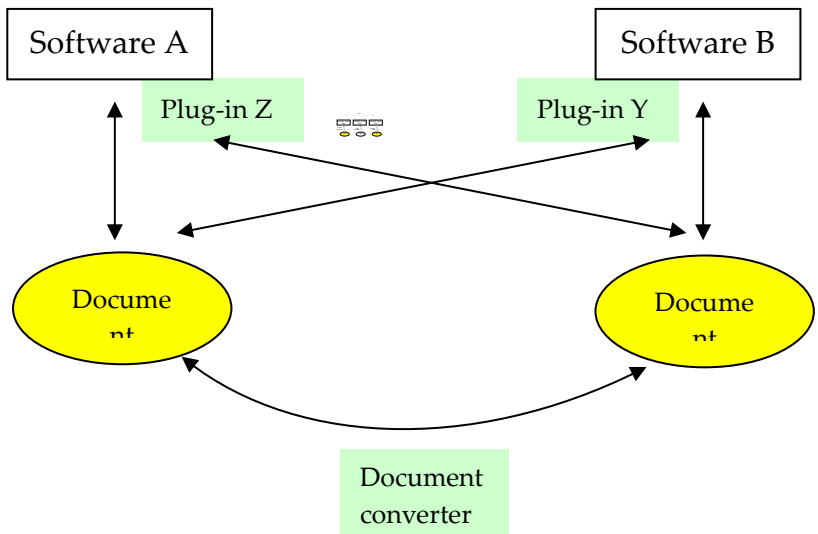

Figure 1: The interoperability implications of having two standards on document formats (Y and Z) in the simplified case of having only two software suppliers.

Two largely overlapping standards undo the full advantages of standardisation. The implications discussed earlier will arguably also apply in this case. That is, having two points of reference is confusing and expensive. It decreases interoperability and raises transaction costs (e.g., inefficiency of document handling). In the period of competition the arrival of a second standard (here: OOXML) supported by a dominant player, is likely to lead to uncertainty among

other software developers, possibly a higher barrier to enter document format-related market niches, and a hold up of investments in ODF. The duplicate efforts in standardization demand extra time and money, resources that cannot be dedicated to software development and innovation. Additional resources are side-tracked to overcome incompatibility (plug-ins) and develop converters. Not least, the advent of OOXML has most probably further secured/ prolonged Microsoftrelated consumer lock-in (i.e., high costs and higher barrier to exit). Furthermore, the lack of a common standard side-tracks resources from innovating in, for example, e-government services.

Where governments take JTC1 to be a trusted source of public standards, they may feel forced to support both standards. Citizens will then have to bear the costs of lack of industry coordination. Apart from being inefficient, a twofold implementation increases the costs of e-government in countries some of which do not have their basic ICT facilities in order. That is, citizens must ultimately bear extra costs of lack of industry coordination – e.g., costs of inefficiency, higher costs of IT use, higher taxes for government IT projects.

2.3.3 Failure of coordinative governance in standardization

Committee standardization is an alternative coordinative mode of market governance. Market players participate on a voluntary basis to develop standards within a set of rules. These rules vary (slightly) across standards fora.

The ISO and IEC have an international reputation for conducting a fair process, aiming to involve all relevant stakeholders and promoting consensus decisions. Having a formal ISO/ IEC status usually implies that the standard is widely supported and stable. Also externally developed specifications like ODF and OOXML can acquire a formal ISO/IEC status. For this, it need not fully under-go the normal, lengthier committee process. Two (very similar) short cuts exist to accelerate the process, i.e., the Fast-track procedure and the

Publicly Available Specification (PAS)-procedure. See Table 1. These procedures have been installed to heighten the visibility of already well-accepted specifications which, because of their maturity, are not expected to undergo (m)any changes. In the case of ODF and OOXML, the benefit of fast tracking for companies is not only a means of marketing their specification but also to more easily acquire access to the considerable market of public procurement[17] (Egyedi, 2001).

Table 1. Comparing ODF and OOXML (Source: Egyedi & Koppenhol, 2010)

	ODF	**OOXML**
Originally submitted by	Sun Microsystems[18]	Microsoft
Standards consortium	OASIS	Ecma International
XML-based	Yes	Yes
Aim of supplier independence	Yes	Yes
ISO/IEC standard	ISO/IEC 26300	ISO/IEC 29500
Year	2006	2008
ISO/IEC standard corresponds to	OpenDocument v1.0 Specification (OASIS May 2005)	ECMA-376 2nd edition (Ecma, Dec. 2008)
Accelerated ISO/IEC JTC1 procedure	Publicly Available Specification (PAS)	Fast Track
• Access to accelerated procedure	Bureaucratic and recurring process	One-time application for A-liaison
• Ballot period	6 months	5 months

[17] According to estimations, public procurement covers 16 - 30% of the IT market in Europe.

[18] http://lists.oasis-open.org/archives/office/200212/msg00003.html

OOXML standardization has undermined the potential coordinative role of JTC1. First, the OOXML specification submitted for fast tracking was not mature. To have nevertheless proceeded, has made JTC1 vulnerable to accusations of serving single industry interests and rubberstamping (i.e., too easy ratification of externally developed specifications).[19] Second, and most relevant here: Ending up with two very similar rival committee standards casts doubt on JTC1's effectiveness in coordinating the IT market and providing a real alternative to market processes.[20]

2.4 Discussion

While standardization is in many cases not desirable, in many other cases it is. There is, however, little general awareness of the negative implications of lack of standardization. In this chapter I have argued that lack of standardization should be viewed as a spectre with at the one end, a diversity of product-specific specifications (i.e., no standard at all, not even a company standard); and, at the other end, two overlapping committee standards. In both cases the coordinative mode of market governance fails. In the case discussed in the introduction, the plugs for mobile phone chargers, lack of standardization illustrates market failure. In the case of the war on document formats standardization failure occurs, that is, a situation in which committee standardization fails to provide the degree of coordinative market

[19] Note that both formal standards bodies like the ITU (Besen, 1991) and standards consortia like W3C (Rada, 2000 p.22) have been accused of 'rubberstamping'.

[20] For example, could partial, local compatibility be valuable? and could competing standards be a useful first step in a two-phased standardization process, with the possibility of convergence lying ahead (Singh & Dahlin, 2009).

governance that would allocate resources efficiently. It is a special instance of market failure.

Whether due to market failure or standardization failure, the negative economic and societal consequences of lack of standardization cannot be denied. The economic consequences include lack of market transparency, uncertainty and hold-ups, incompatibility, inefficiency, waste of resources, and a slow down of innovation; and specifically for competing document format standards, for example, duplicate standardisation efforts, protracted vendor-lock-in, uncertainty about the future accessibility of digital documents, and higher costs for e-government development. The consequences for society differ across case studies, as was illustrated. In the case of plugs for mobile phone chargers the environmental consequences were a key motive for the Commission to intervene. In the document formats case the extra financial burden for citizens, democratic citizenship, and digital sustainability (e.g., cultural heritage) are at stake.

The two extreme cases of lack of standardization suggest that a more pro-active role for government is called for where vulnerable social values such as sustainability and democratic citizenship are implicated. However, to confirm this more systematic research is needed. Such research should include an examination of the circumstances under which lack of committee standardization poses problems and rival committee standards constitute market failure.

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3 Business Models and the Standard Setting Process

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3.1 Introduction

As developed nations have moved further away from traditional manufacturing-based economies and toward more knowledge-based ones, standard setting has grown in importance. Many modern technology products are extremely intricate combinations of components developed by a multitude of different firms based in countries throughout the world – components that must somehow all fit together to create a workable end product, which implies the increased need to define interoperability standards. Most high technology products fit this description and require significant interoperability, including computers, cell phones and the network infrastructures behind them, audio and visual equipment (like DVD players and sound systems), and so forth.

But the shift away from traditional one-company/one-product manufacturing has done more than raise the profile and significance of cooperative industry standard setting – it has altered the process by which standards are set as well.[1] In particular, the move toward a knowledge-based economy has led to the disintegration of the

[*] This paper draws from several previous papers variously coauthored with Vincenzo Denicolò, Damien Geradin, Jorge Padilla, and Klaus Schmidt.

[1] Alternatively, one company defined a de facto standard and that company's suppliers were required to meet its specifications, obviating the need for broad cooperation.

production process, especially in the Information-Communication-Technology (ICT) sector. The knowledge-based design step is now frequently separate from the various manufacturing steps needed to bring a product to the commercial marketplace, which means that the entities participating in cooperative standard setting efforts often have very different business models and hence different objectives for the outcome and method of setting standards.

In this paper, I discuss the business model trends that have emerged over the last several decades and the implications of those trends for standard setting, with a focus on high technology standards. Section 2 looks more closely at how the production process has been pulled apart and what business models we are currently seeing in the marketplace. Section 3 then discusses the implications of business model diversity among standard setting participants and how increased diversity has altered the cooperative process, in both positive and negative ways.

In short, non-integrated production can benefit from "comparative advantage", where entities focus on what they do best, which results in higher quality products and increased consumer choice. But, different business models – like design versus manufacturing, or non-integrated versus integrated – also mean divergent incentives among participants and therefore more disputes among them, which can slow down or even derail the standard setting process, to the detriment of consumers. Section 4 offers concluding remarks. Understanding the drivers of the disputes that can arise within cooperative standard setting is an important first step in identifying ways to resolve the conflicts. The appropriate competition policy recognizes the opposing forces at work in modern cooperative standard setting, seeking balance between them to maximize consumer welfare.

3.2 The Disintegration of the Production Process

The last few decades have seen tremendous change in the way products are made. What used to be the output of one, large, integrated

firm is now often the combined output of many, specialized, smaller firms working in concert. According to Langlois (2003), "vertical disintegration and specialization is perhaps the most significant organizational development of the 1990s." He catalogs a host of industries, including automotive, electronics, pharmaceuticals, and semiconductors to illustrate how widespread the specialization trend has been.[2]

Consider, for example, the pharmaceutical drug industry. A key driver of the industry shift here appears to be an important technological advance – namely the discovery of recombinant DNA technology in 1973.[3] The number of specialist biotechnology firms, that emerged after the discovery of recombinant DNA technology grew from a mere handful in 1975 to 4,414 globally in 2007 (Ernst & Young, 2008).[4] Many of these firms specialize in R&D, producing inter-mediate chemical inputs for prescription drugs or identifying genetic disease markers for pharmaceutical drugs to target, but leaving the development and commercialization of the specific

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[2] See Gilson, Sabel, and Scott, 2008 for more industries that fit the specialization trend.

[3] Decisions surrounding firm structure are quite complicated and are most likely dependent on a host of interrelated factors, including management competencies, corporate law, transaction costs associated with internal firm production as compared to external procurement, and the like. See Jean Tirole, The Theory of Industrial Organization, MIT Press (1994), at 16-51. In this article, I do not conduct detailed assessments of the forces at play in the particular industries considered, but rather highlight the changes that appear to have spurred a change in how firms are structured within the industry.

[4] Of the 4,412 global biotechnology companies in 2007, 798 were publicly held. The United States had 1,502 biotechnology firms in 2007 of which 386 were public (Ernst & Young, 2008).

pharmaceutical drugs and therapies for consumers to larger pharmaceutical companies.[5]

As another example, and one more relevant for standard setting, consider the production of semiconductor chips, which is itself but a single component used as an input in a multitude of other goods, ranging from laptop computers to robotic toys to smart credit cards. In the past, large firms created the chip design and then manufactured the chips themselves, handling the full line of production within a single entity. The strengthening of intellectual property laws in several jurisdictions,[6] and in particular passage of the Semiconductor Chip Protection Act in the United States in 1984, which legally protected the layout of integrated circuits once they were registered,[7] made it easier to split apart various steps of semiconductor production.

Today chip production is typically parsed into at least three distinct steps. Chip design is done mostly by design shops based in Western countries, such as the United States and Western Europe, where significant intellectual property protection can be relied upon. Chip fabrication, in contrast, is handled primarily by large manufacturing plants based in Asia, where labour costs tend to be relatively lower. And chip assembly and testing is also typically handled

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[5] According to the Economist, in 1998 roughly 18% of pharmaceutical R&D funds went toward outsourcing. Carr (1998), at 16.

[6] For example, the establishment of the EPO in June 1973, which has made community patents much easier, the passage of the University and Small Business Patent Procedures Act in the US in 1980 (more commonly known as the Bayh-Dole Act), which has encouraged the commercial dissemination of federally funded research, and the establishment of the Court of Appeals for the Federal Circuit in the US in 1982, which hears appeals arising under US patent law.

[7] Semiconductor Chip Protection Act of 1984, 17 U.S.C. §§ 901-914.

primarily in Asia, but by different entities than the fabrication step. The Fabless Semiconductor Association reports that the number of companies worldwide cooperating in the fabless chip production process grew from roughly 500 in 1997 to about 1300 in 2007 (FSA, Industry & Data, 2008).[8]

Specialization of this sort can bring a number of benefits to an industry, and its consumers. First, as the founding father of economics, Adam Smith, established in the 1700s, specialization enables firms to focus on what they do best, without wasting effort on lower quality or less efficient attempts at other steps in the production process. As a result, specialization enhances productivity and increases output. Today, specialization often emerges in the guise of upstream firms with a focus (a comparative advantage) in R&D and innovation (i.e., "pure" innovators).[9] But, of course, where there are upstream specialists there must be downstream specialists as well in order to complete the production process and deliver a finished good to consumers.

As a second benefit, specialization can lower barriers to market entry. Certainly this was the case in semiconductors. Building a chip fabrication plant is hugely expensive. For example, the Taiwan

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[8] The number of members of the Fabless Semiconductor Association (both design shops and foundries combined) has grown from just 40 in 1994 to over 450 in 2004 indicating a rise in competition both upstream and downstream. (http://www.gsaglobal.org/resources/industrydata/facts.asp).

[9] Another form of upstream specialist is possible as well: patent aggregators. These firms purchase patents but do no R&D of their own. This is a controversial business model, attacked by some as "patent trolls". They fall outside the scope of my analysis, but note that these firms can play a positive role in an industry, offering individual inventors with an outlet for their innovations, increasing liquidity in so-called "technology markets", and reducing the transaction costs that manufacturers face in identifying valuable technologies to implement.

Semiconductor Manufacturing Company (TSMC) will be investing NT$300 billion (€7.36 billion) in its new wafer manufacturing facility in Taiwan, expected to be operational in 2012.[10] By comparison, entering the market as a fabless design shop is far less costly. Even though such upstream entry requires specialized knowledge (the ability to design complex semiconductor chips), the capital expense involved in building a fabrication and/or assembly plant is avoided. Thus once the ability to specialize in design emerged, it is unsurprising that the number of fabless entrants blossomed.

On the downstream side, fabrication specialists, like TSMC, benefit from the economies of scale that come with acting as a contracted outsourced manufacturer, which lowers the cost of production. Moreover, by providing chip fabrication services to multiple design shops, downstream specialists reduce the risk of a downturn in demand for any one product or design.

3.2.1 The Role of Intellectual Property Rights

One important factor (although certainly not the only factor) behind the disintegration trend in a number of industries is the availability of intellectual property rights that enable firms and inventors to protect their designs and innovations without having to first embody them in a physical end product. Hall and Ziedonis (2001) explain this point in the context of semiconductors:

> …the period associated with strong U.S. patent rights has witnessed significant entry into the semiconductor industry by design, or 'fabless', firms that specialize in innovative products but contract out

[10] TMSC Press Release, "TSMC Begins Construction on Gigafab™ In Central Taiwan" Issued on: 2010/07/16.

> the manufacture of their products to owners of wafer fabrication facilities.[11]

In fact, Hall and Ziedonis find that in their data sample fabless chip firms are five times more likely to file for patents than their rival vertically integrated semiconductor firms. Based on both interviews and empirical analysis, the authors conclude that "the importance of patents" lies in their function "as an imperfect but quantifiable measure of technology that enabled technology-based trades to be made in external markets, both in financial markets (venture capital) and with suppliers and owners of complementary technologies."

Arora and Nandkumar (2007) draw a similar conclusion in their empirical study of software encryption and the "information security market". Software was long thought to be protectable through copyright only. But Diamond v. Diehr in 1981 in the U.S. opened the flood gates to patenting software.[12] The ability to patent software

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[11] Hall and Ziedonis (2001) also observe that division of labor in this industry was further aided by a more standardized interface between chip design and the wafer fabrication process.

[12] See e.g. James Bessen and Robert M. Hunt, "An Empirical Look at Software Patents," FRB Philadelphia Working Paper No. 03-17 (2004) at 16. The authors find that software patenting at the USPTO increased by 16 percent per annum between 1987 and 1996. While the Software Directive in the European Union has been debated, but not passed, for many years now, the fact remains that software patents do exist in the EU. Data from the EU indicate that between 2,600 and 5,800 software patent applications were approved per year in the period between 1987 and 1999. See Douglas H. McQueen, "Growth of Software Related Patents in Different Countries,"*Technovation* 25 (2005): 657-671, at 664. The patentability of software is extremely controversial (see, e.g., David S. Evans and Anne Layne-Farrar, "Software Patents and Open Source: The Battle Over Intellectual Property Rights", *Virginia Journal of Law & Technology*, 9 (10) (2004): 2-27; James Bessen and Eric Maskin, "Sequential innovation,

appears to have spurred the creation of software specialization firms. Arora and Nandkumar find that: an increase in the number of upstream licensors leads to an increase of downstream firms lacking their own technology and thus licensing it from others. In other words, patents, which can be licensed in a far more enforceable manner than copyrights facilitate specialization of all sorts, all along the production spectrum.[13]

The pivotal role of intellectual property rights – and patents in particular – in the decision to specialize follows from the inherent differences between tangible and intangible goods. When two parties are negotiating over some physical product, the owner of the product can threaten to take it away at any time if the other party does not live up to his end of the bargain. If a tenant does not pay her rent, she is evicted; if a restaurant does not pay its suppliers, those suppliers stop delivering to the restaurant. Intellectual property cannot, however, be "taken away"; once an idea has been shared, it cannot be unlearned. Although intellectual property protection does not change the fact that a shared idea cannot be revoked, it does provide a mechanism to sue for unauthorized use of the idea and it offers a means to enforce the collection of licensing fees. These mechanisms make knowledge "tradable" and thus the strengthening of intellectual property rights in many jurisdictions has facilitated the componentization of the production process for many industries. Patents are particularly useful in this regard because they offer protection for innovations that could be reverse engineered if disclosed (as trade

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patents, and imitation" *RAND Journal of Economics* 40 (2009): 611-635). That debate, however, has largely centered on the role of patents in spurring innovation. My focus here is on patents facilitating licensing and contractual dealings among separate entities.

[13] See also, Arora, et al. 2001; Arora and Merges, 2004; Arora and Ceccagnoli, 2006.

secrets cannot) and because their codified nature and well understood enforcement mechanism can reduce the odds of a dispute occurring in the first instance.

3.3 How Business Model Diversity Affects Standard Setting

While patents have been among the primary fuels driving the specialization trends throughout the modern economy – and thus increasing comparative advantage, market entry, and competition along the way – they are also at the root of one of the biggest disputes within industry level standard setting. Back when most firms followed the traditional vertically integrated production model, coming up with product ideas and then implementing those ideas in-house, participants in cooperative standard setting generally could agree to a détente in regards to intellectual property licensing. Each integrated firm needed the other integrated firms' patents in order to implement the standard commercially; if one firm demanded significant licensing fees or threatened to sue for patent infringement that firm's necessary and unavoidable trading parties could retaliate by doing the same. This led to a sort of mutually assured destruction, which pushed intellectual property right enforcement lower on a firm's strategic agenda.

And so the firms participating in cooperative standard setting tended to resolve intellectual property issues by cross licensing one another's patent portfolios. Or, even more simply, they would agree to implied royalty free licenses, where it was presumed that the value of one firms' relevant patent portfolio was roughly equal to the value of the other firms' relevant patent portfolio, meaning that contentious and time consuming licensing negotiations over fees and terms could be avoided altogether. These vertically integrated firms all made their profits by selling goods to consumers in the downstream market that embodied the standard and, when seen in that

light, intellectual property was a distraction that was best circumvented whenever possible.

Not so once specialists entered the cooperative standard setting process. Upstream firms, with no downstream production and thus no tangible goods to sell, are generally not interested in cross licensing. Since they do not make products that could infringe on another firm's patents, they do not need to obtain a license to ensure freedom to operate. Instead, upstream firms tend to want royalty revenues, by which they earn their profits and fund additional R&D so as to enable the filing of more patents and thus the continued earning of licensing revenues. Downstream specialists, on the other hand, have no patents to offer for cross licensing, so the previous quid pro quo arrangement does not work for these entities either. These firms need to obtain the relevant licenses to make and sell their goods in the consumer market, but they must pay explicit licensing fees to do so, rather than settling with an in-kind transfer of rights.

With up- and downstream specialists participating in cooperative standard setting alongside traditional vertically integrated firms, a clash of interests was inevitable. First on the list of likely disputes is the matter of what technology to include in a standard. Before, when vertically integrated firms knew they would negotiate cross licenses with one another, the technology included was crucial to ensure downstream commercial success, but any rights on the included technology were by-and-large unimportant. With diverse business models, however, not only is the technology still important for commercialization reasons, but now any intellectual property rights that read on that technology is extremely important as well, since those rights are a key factor dictating the division of rents resulting from the commercialization of the standard.

Upstream firms naturally will want their patented technologies to be included in the standard under development, to ensure the use of their R&D output and thus to ensure their continued licensing revenue streams. Down-stream firms, however, will naturally want to minimize the inclusion of patent-protected technologies to the

extent possible – as long as doing so does not reduce the commercial viability of the standard, which would jeopardize the downstream firms' revenue opportunities. As long as the commercial potential for the downstream market is unaffected, downstream firms would prefer to build standards on public domain solutions or on technologies offered by firms not actively seeking to license or enforce their intellectual property. Vertically integrated firms will fall between these two preferences: including their own patented technologies can provide integrated firms with a first-mover competitive advantage in producing the downstream goods embodying the standard, particularly against downstream specialists, but like downstream specialists integrated firms also will want to minimize the inclusion of intellectual property that requires the payment of royalties to other parties, as such fees represent production costs.

Second on the list of likely disputes is the matter of how to license the patents that are deemed essential for implementing the standard. Since upstream specialists earn their profits through licensing revenues, these firms have an interest in setting royalty fees as high as the market will bear (without shrinking end user demand) in order to maximize their profits. Such firms will be constrained by the impact that their licensing fees have on product demand in the marketplace and by competition from other technology providers, but within those confines upstream specialists will desire healthy licensing fees. Downstream specialists, in contrast, want to earn the highest profit possible in the sale of goods incorporating the standard. Hence, they view licensing fees as pure costs, to be reduced to nothing if at all possible. Integrated firms will again lie somewhere in the middle of these two extremes, depending on the strength of their patent licensing programs. To the extent that an integrated firm relies upon licensing revenues to fund its operations, it will tend to be more amenable to positive royalty rates; to the extent that it views intellectual property licensing as a distraction from its core activities in the downstream market, it will prefer cross licensing agreements and restrictions on licensing fees.

3.3.1 The Disputes

These two key differences in incentives – whether (and how much) protected technology to include in a standard and how to license it once included – are at the root of many of the disputes arising in cooperative standard setting. So, for example, some of the issues discussed in other chapters of this book, including allegations of "excessive royalties" (or non-FRAND licensing) and patent "hold-up", are often at their heart disagreements deriving from differences in business models.

Claims of non-FRAND licensing, for instance, are often made against upstream firms by vertically integrated firms or downstream specialists. At the most cynical level, these claims might be viewed as negotiation posturing, with buyers simply attempting to lower the purchase price of an input good to its bottommost level. At the other cynical extreme, these claims might indicate a patent holder attempting to exploit marketplace circumstances to earn more than its portfolio of relevant and essential patents is justifiably worth. Most commonly, however, these disputes likely represent the divergence of firms looking on the same set of facts from different perspectives, which colour their perceptions. In other words, reasonable entities can disagree over such matters as licensing terms and conditions.

Likewise, assertions of patent "ambush", where the patent holder is alleged to have withheld information on its intellectual property until after the standard is fully defined and is being implemented in the marketplace, are typically directed at firms with no downstream presence (upstream specialists). Again, some of these claims could be warranted, reflecting attempts at deception on the part of a patent holder. Other claims are likely to reflect poor due diligence, or an outright turning of a blind eye, on the part of downstream suppliers attempting to avoid paying any licensing fees at all. Still other instances are likely to reflect honest oversight from both parties – a scenario that is understandable given the huge number of patents underlying some complex products and the subjective nature of determining which patents might read on a new product or service.

And finally, upstream firms with patent portfolios that they view as commercially valuable will often resist efforts by other entities to create patent pools for the essential intellectual property for a particular standard. Such pools may cap royalty rates – indeed some entities announce the capping of licensing fees as a key goal when disclosing the formation of a new pool.[14] For example, vertically integrated firms earning the bulk of their revenues from the downstream sale of goods and downstream specialists earning all of their revenues through the sale of goods may push for patent pools with limited royalty rates in an attempt to shift rents from the upstream to the downstream. Upstream specialists, on the other hand, will either work to alter the licensing terms a particular pool will apply, to allow for a reasonable return on their patents, or they will refuse to join the patent pool altogether.

3.4 Conclusions

Understanding the origins of the disputes that can arise within cooperative standard setting is a crucial step in finding ways to resolve them. While one popular (albeit highly controversial) view sees all "non-practicing" or "non-competing" patent holders (i.e. upstream specialists) as harmful entities preying upon those firms that actually contribute goods to society,[15] that view ignores the forces explained

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[14] See, e.g., the efforts surrounding the CDMA2000 patent pool. SISVEL press release, "SISVEL Launches Patent Pool", 10.06.2009, http://www.sisvel.com/english/news/sisvelnews/cdma2.

[15] In fact, the U.S. Federal Trade Commission espoused this view in its 2003 report on promoting innovation, where conduct by "non-producing entities" as the instigators of litigation was a key focus because these entities were not subject to constraints imposed by quid-pro-quo cross licensing (FTC, 2003, at ch. 2, fn 220; ch. 3, pp. 38-41). This view ignores the fact that

in this paper. Specialization, including upstream specialization, can be distinctly positive for an industry and its customers. In particular, specialization can result in higher quality products (through comparative advantage) along with greater market entry up- and downstream, and thus can lead to increased competition with resulting lower prices for consumers. It is not surprising, then, when legal or technological circumstances that facilitate specialization in fact lead to more specialization.

These benefits of specialization, however, come at the cost of a more complicated cooperative standard setting process with greater odds of clashes among the diverse participants. In industries that have experienced increased specialization – and this includes most of the "new economy" industries in high technology – we can expect more allegations of anticompetitive behaviour within standard setting organizations, simply arising from the fact that the participants in these organizations have vastly different incentives and profit models.

These benefits, however, come at the cost of a more complicated cooperative standard setting process with greater odds of clashes among the diverse participants.

In considering the role that competition agencies should play in standard setting, it is important to keep these countervailing forces in mind and thus to move away from any overly simplistic association between non-practicing entities and the automatic assumption of anticompetitive conduct. As the above discussion illustrates, non-practicing entities evolve from market forces and can play a decidedly pro-competitive, welfare enhancing role in an industry. In assuming that one business model has more legitimacy than another,

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non-practicing entities face a number of constraints aside from those presented by cross-licensing that limit their incentives and ability to practice hold up (Schmidt, 2006).

or that one organizational approach is more prone to anticompetitive behavior than another, we run the very real risk of misguided policy decisions. Instead, any policy proposals aimed at firm conduct within cooperative standard setting contexts therefore should be carefully evaluated both in terms of the direct effects on the perceived competitive problem as well as any indirect (unintentional) detrimental impact on patent-facilitated competition and frequently welfare-enhancing upstream specialization within the industry at hand.

As one example, consider the rules determining which parties can seek injunctive relief in a patent infringement dispute. Manufacturers often argue that the threat of injunction is disproportionate, particularly where a given patent (or set of essential patents) reads only on one component of a good, bringing production of that good to a halt may appear to be overkill. Thus, some have called for injunctive relief to be categorically denied to upstream patent holders. For example in eBay v. MercExchange, the concurring opinion of Supreme Court Justice Kennedy, with whom Justices Stevens, Souter, and Breyer joined, wrote that:

> In cases now arising trial courts should bear in mind that in many instances the nature of the patent being enforced and the economic function of the patent holder present considerations quite unlike earlier cases. An industry has developed in which firms use patents not as a basis for producing and selling goods but, instead, primarily for obtaining licensing fees. … For these firms, an injunction, and the potentially serious sanctions arising from its violation, can be employed as a bargaining tool to charge exorbitant fees to companies that seek to buy licenses to practice the patent.[16]

The rationale for this policy proposal is that these firms do not have downstream products and hence are only interested in past damages and ongoing royalties, so harsh injunctive relief is not warranted.

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[16] See Ebay Inc. v. Mercexchange, L.L.C. 547 U.S. 388, 396-97 (2006).

This argument is true at one level, but it ignores the long term repercussions of denying parties any recourse to seek injunctive relief.[17] Specifically, once upstream patent holders have no option of seeking injunctive relief, they will have no bargaining power at all in licensing negotiations. Especially within standard setting contexts, where the parties typically commit to license via a FRAND promise, such a rule would amount to compulsory licensing, leaving upstream patent holders at the mercy of licensees. Implementers of the standard could hold out as long as possible in obtaining any license at all, waiting for patent holders to go to the expense and trouble of taking them to court for infringement. At that point, even if a downstream firm were found to be infringing, it would only have to pay reasonable past damages and settle upon a royalty for future production. Under these circumstances, downstream firms can be expected to hold out as long as possible in obtaining any license from upstream specialists and upstream firms would be pushed to settle for undercompensating rates and terms.

I therefore suggest that the policy debate surrounding cooperative standard setting should place its attention on finding meaningful ways of identifying harmful behaviours within the cooperative standard setting process, remaining neutral as to the organizational choices made by the firms participating in that process. Factors such as a lack of ties and commitment to an industry or clearly documented evidence of attempted deception might be more fruitful indicators of intended anticompetitive behaviour within a standard setting organization.

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[17] Observe that I am arguing only for the ability of all parties, regardless of their business model, to seek injunctive relief. Courts will still need to assess each request on its merits under the circumstances at hand.

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4 Standards, Innovation Incentives and the Formation of Patent Pools

Klaus M. Schmidt[*]

4.1 Introduction

Whenever high technology products of different firms interact with each other technological standards are required. These standards are based on patents that are often owned by different patent holders. Each patent holder, when setting the royalty for his patents, does not take into account that an increase of his royalty rate reduces demand for the final products and thereby reduces the profits of the other essential patent holders. This externality is the so called "complements problem" that gives rise to excessively high royalties.

A straightforward solution to the complements problem is a patent pool that jointly markets all essential patents. Even though a patent pool is a cartel that fixes an essential input price for downstream products, competition authorities acknowledge that patent pools of complementary patents can be procompetitive if they reduce royalty rates and transaction costs by allowing for "one-stop shopping". In Section 4.2 I review and discuss the complements problem and the role played by patent pools in more detail.

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While the impact of patent pools on royalty setting is fairly well understood, much less is known about their dynamic effects. The prospect of a patent pool increases future profits and thereby presumeably increases the incentives of the involved parties to invest into the technologies they contribute to the standard. However, there are two problems. First, if firms compete to get their technology included in the standard and to be a member of the patent pool there is a "business stealing effect" that may induce firms to invest too much. Second, a patent pool solves the complements problem but not the team production problem that arises when the investment of one firm benefits all other firms that belong to the pool. This induces firms to invest too little. In Section 4.3 I discuss how to induce firms to invest efficiently. There I show that patent pools requiring grantbacks that are formed at an early stage of the standardization process can play an important role to improve innovation incentives.

Even though patent pools can have many desirable properties firms often fail to form a pool that includes all essential patents. In many cases no pool is formed at all. Instead standard setting organizations require their members to set "reasonable and nondiscriminatory" (RAND) royalties.[1] RAND commitments prevent outright refusal to license and exclusive licensing, but they impose hardly any additional constraints on royalties. As Swanson and Baumol (2005) put it: *"It is widely acknowledged that, in fact, there are no generally agreed tests to determine whether a particular license does or does not satisfy a RAND commitment."* Thus, they do not solve the complements problem. But even if a patent pool is formed, it is often the case that some holders of essential patents choose not to join it because they are better off free riding on the low royalties chosen by the firms that are in the pool. In these cases the pool mitigates the complements problem, but it does not fully solve it. In Section 4.4 I

[1] In Europe many SSOs require royalties to be "fair" in addition.

discuss the incentives of firms to form a patent pool. The more firms there are the larger is the problem of pool stability. I propose a new procedure for the approval of patent pools that I call "full functionality approval". This procedure makes every patent holder pivotal for the viability of the pool. If it was adopted by competition authorities it would be much easier to form welfare increasing patent pools.

In Section 4.5 I briefly discuss some policy implications of the theoretical analysis. I argue that competition authorities should not just tolerate but actively encourage and support patent pools that satisfy certain conditions. In particular they should allow for early patent pools that require grantbacks even if fairly high royalties are set. This encourages innovation and does not reduce social welfare if royalty rates can be renegotiated. I also argue that competition authorities should adopt a system of "full functionality approval" in order to solve the free rider problem in pool formation.

4.2 The Complements Problem

Cournot (1838, Chapter 9) was the first to discover that if a good requires complementary inputs that are supplied by different firms each of which has market power then the suppliers exert an externality on each other that may result in excessively high prices, prices that are even higher than the monopoly price. To illustrate his point Cournot used the example of the market for brass. Brass is produced from copper and zinc in fixed proportions (about 2:1, depending on the type of brass). Suppose that these two inputs are controlled by two different monopolists. When setting his price the copper monopolist does not take into account that by increasing his price he reduces the profits of the zinc monopolist, because an increase in his price reduces the demand for brass and thereby also the demand for zinc. Similarly, an increase of the zinc price reduces the demand for copper which is not taken into account by the zinc monopolist. In equilibrium the two monopolists charge prices that are higher than the prices that an integrated monopolist (supplying

both copper and zinc) would choose. This implies that if the two monopolists could form a cartel they would agree to cartel prices that are lower than current market prices and that would benefit both, the two monopolists and consumers. In fact, this problem is very similar to the double marginalization problem that arises in a chain of monopolies, where vertical integration can raise industry profits and social welfare.

4.2.1 Standard Setting and Patent Thickets

At first glance Cournot's example may seem extreme and not very realistic, but due to recent technological developments an even more extreme situation arises frequently with high technology products that interact with each other or with complementary products. Interaction requires that all products comply with the same technological standard. For example, a cellphone can communicate with another cellphone only if both of them use the same communication standard (such as UMTS) , a DVD can be read by different DVD players only if all comply with the same DVD standard, and so on. These technological standards use dozens or even hundreds of patents owned by many different IP holders.

Ex ante, before the standard is set, there may be several different technological solutions to a given problem and therefore several different patents competing with each other. Ex post, however, after one solution has been selected and the standard has been set, the patents required for this standard become "essential": Because large investments in the development of products based on this standard have been sunk it is impossible or prohibitively expensive to circumvent the patents used by the standard. Each holder of an essential patent is now a monopolist controlling the supply of a complementary input. The more different patent holders there are, the more severe the complements problem is. Shapiro (2001) who rediscovered the relevance of Cournot's original analysis for high technology markets calls this situation a "patent thicket".

4.2.2 Cross Licensing Agreements and Patent Pools

Natural solutions to the complements problem are cross licensing agreements and patent pools. With a cross licensing agreement two firms owning complementary patents license their patents to each other at low royalties or royalty free. Cross licensing agreements can solve the complements problem between two symmetric firms that both own complementary patents and that both use these patents for the production of some downstream good. However, they have two disadvantages. First, they cannot be used if one of the firms is a technology specialist who owns an essential patent but does not produce on the downstream market because such a firm has no use for the patent of the other patent holder. Second, when the number N of essential patent holders grows the number of required cross-licensing agreements grows to $\sum_{n=1}^{N-1} n = \frac{N(N-1)}{2}$. Thus, when many potentially asymmetric firms are involved a patent pool outperforms cross licensing agreements. Ideally, the patent pool contains all patents that are required for the standard and licenses them as a bundle. The royalty income of the pool is then distributed according to a predertimend sharing rule among the patent holders. The patent pool internalizes the complements problem and reduces transaction costs by allowing for "one stop shopping".

To be sure, a patent pool is an agreement to fix input prices, i.e. a cartel. A patent pool always has an incentive to charge a price for the bundle of patents that maximizes industry profits and implements the monopoly price on the downstream market. If the patents are substitutes, this may turn a competitive market into a monopoly and lower social welfare. However, if the patents are complements the monopoly price is lower than the sum of the royalties that the firms would charge individually. Thus, the patent pool reduces the price for the bundle of patents and raises social welfare. Furthermore, the monopoly price is socially desirable. After all, patent holders have

been granted a monopoly on their patents by the government as a reward for their innovation efforts.

4.2.3 Vertically integrated and Non-integrated Patent Holders

Some patent holders are technology specialists who are active only on the upstream market for technology, while others are vertically integrated and also manufacture products that are sold downstream to final consumers. It is sometimes argued that in the absence of a pool vertically integrated firms will charge lower royalties because they are more concerned about the downstream market. Kim (2004) and Schmidt (2008) show that this need not be the case. To the contrary, vertically integrated firms have an incentive to increase royalties in order to raise their rival's costs.

However, with a patent pool there is a conflict of interest between vertically integrated and non-integrated firms when it comes to the determination of royalties charged by the pool. Vertically integrated firms make part of their profits downstream. They have an incentive to lower royalties in order to shift profits downstream at the expense of non-integrated patent holders who make all their profits upstream. Thus, it may be difficult to agree to a patent pool if patent holders are asymmetric.

4.2.4 Distinguishing Patents that are Complements from Patents that are Substitutes

The papers considered so far assume that all patents are perfect complements. Indeed, the recent doctrine of competition authorities

is that only essential patents be included in a patent pool.[2] When all patents are perfect complements a patent pool unambiguously increases social welfare, and it unambiguously decreases social welfare when all patents are perfect substitutes. However, it is often unclear whether patents complement each other or compete with each other. Lerner and Tirole (2004) have shown that whether patents are complements or substitutes is endogenous and depends in general on the licensing fees charged for them. Thus, it may be difficult for competition authorities to determine whether a patent should be allowed in a pool or not.

However, Lerner and Tirole also point out a simple screening mechanism to distinguish welfare-increasing patent pools from pools that lower welfare. They show that welfare-decreasing pools are unstable if independent licensing by pool members outside the pool is possible, while welfare-increasing pools are unaffected. If patents are substitutes patent owners can compete outside the pool and thereby undermine the cartel. If patents are complements this option is unattractive and not harmful to the pool. It may even be beneficial if the patents can be used for other applications. Thus, requiring patent pools to grant permission to independent licensing is a simple safeguard against welfare-decreasing pools. In fact, in an empirical study of 63 patent pools formed in the US between 1895 and 2001 Lerner, Strojwas and Tirole (2007) find that patent pools are indeed more likely to have independent licensing when patents are complements.

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[2] The Department of Justice and the Federal Trade Commission have softened this stance in their joint report on antitrust and IP issued April 2007 (http://www.ftc.gov/opa/2007/04/ireport.shtm). Now they acknowledge that including substitute patents need not be anti-competitive. Patent pools will be reviewed according to the rule of reason in the future. See also Layne-Farrar and Lerner (2008, p. 8).

4.3 Patent Pools and the Innovation Incentives

While the complements problem and the beneficial effects of patent pools on pricing are well understood by now, the literature has largely ignored the question of which effect a patent pool has on the incentives of the involved firms to develop new and improve existing technologies. Two types of innovations have to be distinguished. *Ex ante* innovations are innovations that are made before a standard is formed. Firms compete to get their technologies into the standard. *Ex post* innovations are innovations that can be made after the basic technologies for the standard have been selected. A firm contributing to the standard can then invest to further improve its technology.

A patent pool increases the profits made by the firms that own IP rights that are essential to the standard. Thus, the anticipation of a patent pool always increases the incentives to invest. However, in the case of *ex ante* innovations firms may invest too much, while they always invest too little in case of *ex post* innovations.

4.3.1 Ex ante Innovations

Dequiedt and Versaevel (2006) consider a dynamic model with N symmetric firms each of which invests continuously over time. Innovations are modeled by a Poisson process. A patent pool is formed if $K < N$ independent innovations have been made. The value of an innovation is larger when it is included in the pool. Thus, there is a patent race where each firm tries to be among the first K innovators. The prospect of the pool increases investment incentives. Moreover, the investment pattern is upward sloping over time until the pool is formed. Note, however, that the private value of being in the pool is larger than the social value. Thus, there is a "business stealing effect" and firms may have an incentive to invest too much.

Gilbert and Katz (2009) ask how the overinvestment problem can be solved. They also consider a patent race model. There are K innovations required for a new standard to work, but only two firms

competing to make these innovations. The innovations are perfect complements. If each firm makes at least one innovation then both firms are required for the standard. If one firm makes all K innovations then this firm is a monopolist and sets up the standard alone. Thus, on the one hand, each firm has an incentive to underinvest because there is a free-rider problem. A discovery made by firm 1 also benefits firm 2 if both of them are required for the standard. On the other hand, a firm has an incentive to make all discoveries itself in order to prevent the other firm from participating in the standard. If the latter "business stealing" effect is sufficiently strong, firms invest too much. Gilbert and Katz (2009) characterize the optimal sharing rule that induces both firms to invest efficiently. The optimal rule is linear in the number of patents owned by each firm. In order to induce firms to invest efficiently the optimal sharing rule has to be complemented by a tax (or subsidy) imposed by the government that reduces the profits of the patent pool and thereby investment incentives. Unfortunately, the optimal tax depends on the parameters of the model and is therefore difficult to implement in practice.

4.3.2 Ex post Innovations

Another interesting and important case is the ex post situation where the standard has been formed and the major technologies have been chosen already, but before the standard is commercially implemented additional innovations that improve the standard can be made.

Layne-Farrar (2009, p. 4) considers ex post innovation and patenting in the 3G mobile telecom standard. She reports that "at the time the technology for the UMTS mobile telecoms standard was selected, the document specifying a crucial component was only 30 pages long, but by the time the standard was ready for commercial

implementation the page count had increased to over 13,000." This suggests that ex post innovation is indeed important.[3]

The analysis of this case is straightforward. Consider a situation where N firms each contributed a basic technology to the standard. Suppose that M of these firms, $M \leq N$, can now make an investment that improves the quality of their technology. Higher quality may result in lower production costs for downstream producers or in higher valuations of consumers. Without a pooling agreement firms impose two externalities on each other. First, because of the complements problem royalties will be set too high. This reduces demand for the final product and thereby reduces the incentive to invest for each firm. Second, investing in quality increases the demand for the final good and thereby the demand for the complementary patents. This gives rise to a team production problem. Each firm benefits from the investment of the other firm: When choosing its investment level a firm does not take into account the positive external effect of its investment on the profits of other patent holders. Thus, again, this induces firms to invest too little.

Suppose now that firms know at the time of their investment decisions that a patent pool will be formed licensing all essential patents as a bundle. Because the royalties charged by the pool are lower than the sum of the royalties firms would charge individually, the total quantity sold downstream and total profits increase which increases each firm's investment incentives. The patent pool solves the complements problem given the investments that have been undertaken, but it does not solve the team productioin problem. It is

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[3] It is sometimes argued that ex post patenting is opportunistic and aimed at shifting rents and getting a larger share of the standard's royalty revenues. However, Layne-Farrar (2009) rejects the hypothesis that all ex post patenting is opportunistic and only directed at shifting rents. Instead, on the basis of reasonable empirical measures she finds that many ex post patents are valuable and reflect genuine innovations.

still the case that each firm has to share the fruits of its investment with all other essential patent holders. Thus, investments are lower than if all firms were fully integrated.

Is it possible to solve the team production problem and to induce efficient ex post innovations, i.e. innovations that a fully integrated firm would have chosen? The problem is that the royalty rate is endogenously determined by the investments. If the royalty could be set exogenously it would be easy to induce efficient investments. The marginal benefit of the investment is the marginal increase of downstream production due to the higher quality of the standard times r_i, the royalty rate collected by firm i. If r_i is set such that the marginal benefit of investment equals marginal cost of investment at the efficient investment level, the firm will invest efficiently.

This can be implemented by giving the patent pool the option to buy out the patent holders who invested. Suppose that $M < N$, i.e. there are some pool members who do not invest. When the standard is set all essential patent holders form a patent pool that contains the relevant patents on which the standard is based. Furthermore, all contributing parties commit to include all future patents that are required by the standard to the patent pool, i.e., so called "grant-backs" are imposed.[4] The patent pool fixes optimal linear royalties r_i that induce each investing party i to invest efficiently. The problem is that ex post these royalties are likely to be inefficient, so firms have an incentive to renegotiate them. Suppose the patent pool has the option to make a take-it-or-leave-it offer to buy out those members that had to invest. They are offered a fixed fee equal to the royalty income they would have received in the absence of renegotiation. This leaves their investment incentives unaffected. Then the pool chooses the optimal royalty rate that maximizes industry profits.

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[4] Grantbacks are a regular feature of many patent pools with complementary patents. See Lerner et al. (2007).

It is important that the renegotiation offer is made by a party that does not invest to induce the other parties to invest efficiently. But even if all parties have to invest the mechanism of forming an early patent pool with high royalties that are renegotiated downwards after investments have been sunk can increase investments and welfare as compared to a situation where no early pool can be formed.

4.4 Voluntary Participation in a Patent Pool

Patent pools for complementary patents have very desirable properties, but in many cases they are not formed or do not include all essential patents. The problem is that firms have to join a patent pool voluntarily, and they often choose not to do so. Sometimes firms participate in the standard setting process to make sure that their technology is included in the standard, but then refuse to join the patent pool. For example, shortly before the establishment of the MPEG-2 pool, Lucent chose not to participate because it concluded to be better off licensing outside the pool than being a pool member.[5] Sometimes a patent pool break up and several mutually exclusive patent pools are formed. For example, there were ten firms involved in the standard setting efforts for digital versatile discs (DVDs). However, after the standard was set these firms split up into two mutually exclusive patent pools. Even though industry experts agree that this is inefficient, firms have been unable to agree to one large pool.[6] A manufacturing firm has to license both patent pools in order to be compliant with the standard.

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[5] See Layne-Farrar and Lerner (2008, p. 7).

[6] See Merges (1999, p. 36-37) for a discussion of why two separate pools formed.

4.4.1 Free-Riding on the Pool

The reason for the failure to form an all inclusive patent pool is again a free rider problem. It would be profit maximizing for the group of all essential patent holders to form a patent pool and charge the full integration royalty rate for the bundle of all essential patents, but for any individual patent holders it is even better not to join but to free-ride on the low royalty set for the other patents in the pool by charging a higher royalty rate himself.

Aoki and Nagaoka (2004) consider a firm's incentives to join a patent pool. They show that if there are three or more symmetric patent holders that do not produce on the downstream market, then not joining the pool is always profitable as a unilateral conduct (i.e., as long as the other parties still form a pool). Furthermore, if there are different types of firms, some vertically integrated (i.e. owning essential patents but also manufacturing output) and some "R&D only" firms (i.e. owning essential patents but not producing downstream), then there is a conflict of interest. As discussed in Section 2.3 already, vertically integrated firms want royalties to be low in order to shift profits to the downstream market, while "R&D only" firms want royalties to be higher because they make all their profits upstream. Thus, vertically integrated firms have stronger incentives to join a patent pool than non integrated firms.

4.4.2 Patent-Pool Participation under Different Sharing Rules

Layne-Farrar and Lerner (2008) present empirical evidence on the factors affecting the decision to join a patent pool. They find that vertically integrated firms are indeed more likely to join a pool. They also look at how different sharing rules affect the incentives to join. They show that pools adopting numeric proportional sharing rules (royalties are shared in proportion to the number of patents submitted to the pool) tend to attract fewer joiners because simple patent

counting does not reflect the value of the patents. Furthermore, firms with more valuable patent portfolios (as measured by citations) alre less likely to join a pool that uses a numeric proportional sharing rule.

Layne-Farrar, Llobet and Padilla (2010) theoretically evaluate another sharing rule that has been proposed as a means of avoiding patent hold up. The "incremental value rule" rewards each firm equal to the value that their patented technology contributes to the standard on an *ex ante* basis (compared to the next best alternative). This rule has many attractive properties, but the authors show that it fails to induce firms to join a patent pool whenever this is efficient. The larger the number of essential patent holders, the lower is the probability that a pool will be formed.

4.4.3 Patent Pool Stability

Aoki and Nagaoka (2004) consider the incentives of an individual patent holder to join a pool, assuming that the pool will be formed in any case. However, this is not necessarily the case. If firm 1 does not participate in the pool it may be optimal for the remaining $N-1$ firms not to join a pool either. This stabilizes the "grand pool" (that includes all essential patents): If firm 1 anticipates that its refusal to join the pool will induce all firms to break off as well and to set their royalties non-cooperatively, then firm 1 is better off joining the pool. Aoki and Nagaoka (2005) analyze this problem as a coalition formation problem using the tools of cooperative game theory. They show that if the number of essential patent holders grows it becomes more and more difficult to sustain pool stability.

To illustrate this point consider a simple example: There is a perfectly competitive downstream market with a linear demand function $Q = A - b \cdot p$, where Q is the total quantity sold, A, b > 0 are parameters, and p is the market price. In competitive equilibrium the market price is equal to the perceived marginal cost of the down-

stream firms, so $p = c + \sum_{i=1}^{N} r_i$, where c is the marginal cost of downstream production and r_i is the royalty charged by patent holder i, $i \in \{1,...,N\}$. Consider the following three situations.

- <u>*Non Integration:*</u> If all N firms choose their royalties non-cooperatively there is a unique symmetric Nash equilibrium in which each firm sets $r_i^{NI} = \frac{A-bc}{b(N+1)}$ and makes profit $\Pi_i^{NI} = \frac{(A-bc)^2}{b(N+1)^2}$.

- *Full Integration:* If a grand patent pool forms each patent holder charges $r^{FI} = \frac{A-bc}{2Nb}$ and makes profit $\Pi_i^{FI} = \frac{(A-bc)^2}{4Nb}$.

Partial Integration: If $N-1$ firms form a patent pool while firm 1 sets its royalty rate non-cooperatively, then there is a unique symmetric Nash equilibrium in which firm 1 chooses $r_1^{PI} = \frac{A-bc}{3b}$ and the pool chooses for each of its members

- Full Integration: If a grand patent pool forms each patent holder charges $r^{FI} = \frac{A-bc}{2Nb}$ and makes profit $\Pi_i^{FI} = \frac{(A-bc)^2}{4Nb}$.

Partial Integration: If $N-1$ firms form a patent pool while firm 1 sets its royalty rate non-cooperatively, then there is a unique symmetric Nash equilibrium in which firm 1 chooses $r_1^{PI} = \frac{A-bc}{3b}$ and the pool chooses for each of its members $r_i^{PI} = \frac{A-bc}{3b(N-1)}$, $i \in \{2,...,N\}$. In this case $\Pi_1^{PI} = \frac{(A-bc)^2}{9b}$ and $\Pi_i^{PI} = \frac{(A-bc)^2}{9b(N-1)}$.

Note first that $\Pi_i^{FI} > \Pi_i^{NI}$, i.e. all firms are better off with the grand patent pool than with non integration. Note also that $\Pi_1^{PI} > \Pi_1^{FI}$, i.e. firm 1 is better off not joining the pool if all other firms form a pool of size $N-1$. This is the free-rider problem. Thus, the crucial question is whether it is profitable for the remaining $N-1$ firms to form a pool of their own. If $N < 5$ it is easy to check that $\Pi_i^{PI} < \Pi_i^{NI}$, so they will not form a pool. This stabilizes the grand pool. Each firm anticipates that if it does not join the grand pool then no pool will be formed, so each firm has an incentive to join. In $N = 5$ the remaining 4 firms are just indifferent whether to form a pool on their own or

not. If $N > 5$ we have $\Pi_i^{PI} > \Pi_i^{NI}$, so the remaining $N-1$ firms will always form a pool which induces firm 1 not to join the grand pool.[7]

4.4.4 With a Little Help from the Competition Authority

The free rider problem could be solved if each firm was pivotal: If it does not join the grand pool then no pool will be formed and all patent holders will choose their royalties non-cooperatively. However, the previous example shows that this threat is not credible for large N, because even if some essential patent holders do not join the grand pool it is still optimal for the others to form a smaller pool without them.

This problem can be solved if the competition authorities adopt the following procedure for getting a patent pool approved. I will call this procedure "Full Functionality Approval":

- The full functionality of the standard has to be described, i.e. what can be achieved by the standard without access to any additional patent rights.
- The maximum total royalty for the bundle of all patents has to be specified.

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[7] Unfortunately, the analysis of Aoki and Nagaoka (2005) is incomplete. They do not consider the possibility that if N grows larger, it becomes more attractive for (N-1) firms to form a pool on their own, but this pool may also become unstable: firm 2 may choose not join any pool if it expects the remaining (N-2) firms to form a pool. This in turn could induce firm 1 not to leave the grand pool in the first place. In the linear example given above this does not cause a problem. With N>5 the grand pool will never form. However, this problem has not been ruled out in general.

- Each patent holder keeps the right to license his patents independently outside the pool.
- Grantbacks are imposed, i.e. each patent holder commits to include all future patents in the pool that are essential to the standard.

The patent authority approves the patent pool under the condition that no additional patents are required to achieve the described functionality. Thus, it is the responsibility of the patent pool to include all relevant patents. If a licensee proves to the competition authorities that full functionality cannot be achieved legally with the patents included in the pool or that he has to pay higher royalties in order to achieve legal full functionality, then this licensee can use the patents of the pool for free. If the competition authority learns (this way or another) that additional patents are required to achieve full functionality, then the approval of the patent pool is null and void and each member has to charge his royalties non-cooperatively.

Suppose that the competition authority adopts "Full Functionality Approval". Consider a standard that requires N essential patents to be fully functional. If a patent pool adopts a sharing rule that gives each essential patent holder at least as much as he would have received if all patent holders set their royalties independently, then all patent holders will join the patent pool. Because the patent pool is efficient such a sharing rule always exists.

Full Functionality Approval makes every essential patent holder pivotal. If he does not join the pool, full functionality cannot legally be achieved without infringing on his patent, so a pool will not be approved, or approval will be withdrawn as soon as he complains that the standard infringes on his patent rights. Thus, any patent holder not joining the pool causes all other patent holders to set their royalty rates non-cooperatively. The patent pool gives each patent holder at least as much as he would have gotten if royalties were set non-cooperatively, so it is optimal for each patent holder to join. Because the pool is more efficient than non-cooperative royalty setting

it is always possible to share the royalties of the pool such that each patent holder is better off.

Note that licensees play an important role for this mechanism to work. If there is an essential patent holder outside the pool charging additional royalties, the pool has an incentive not to raise this issue with the competition authorities if it is afraid that the pool will be dissolved. However, a licensee has a strong incentive to report this to the competition authorities because he is rewarded with a free license for all patents in the pool. The free license does not expropriate pool members because they voluntarily agreed to join the pool under the conditions of Full Functionality Approval.

This mechanism has the additional advantage of deterring so called "patent trolls", i.e. firms secretly holding patents that are essential for the standard. A patent troll waits until the standard has been set and large investments have been sunk. Then he steps out, sues the other patent holders for infringing on his patent and uses an injunction to hold them up.[8] With Full Functionality Approval this strategy is self-defeating. If a patent troll sues the other patent holders the pool is automatically dissolved. Thus, negotiations about a new pool have to start from scratch. All patent holders are again symmetric and there is no benefit to the patent troll from hiding his patent. The members of the old patent pool will offer to add his patent to the other N patents in a new pool and to give the patent troll a share of 1/(N+1) of the pool royalties. Because in this situation all patent holders are symmetric the patent troll cannot expect to extract a higher share of the pool revenues. This is what he would have gotten in the first place had he participated in the forming of the old pool. Thus, being a patent troll does not pay off.

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[8] See Lemley and Shapiro (2007) and Layne-Farrar and Schmidt (2010) for a more detailed discussion of "patent trolls".

4.5 Policy Implications

Because a patent pool is an agreement to fix input prices, it can and has been used to form a cartel and to suppress competition on markets that would otherwise be competitive. This is the reason why patent pools have been considered illegal per se by the US antitrust authorities until the mid 1990s.[9] Competition authorities have come to treat patent pools for complementary patents more favorably in recent years. For example, in the *Antitrust Guidelines for the Licensing of Intellectual Property Rights* (1995, p. 28), jointly issued by the US Department of Justice and the Federal Trade Commission, it is acknowledged that patent pools "provide procompetitive benefits by integrating complementary technologies, reducing transaction costs, clearing blocking positions, and avoiding costly infringement lititation"[10]. However, the agencies also point out that "pooling arrangements can have anticompetitive effects", and that when "pooling arrangements are mechanisms to accomplish naked price fixing or market devision, they are subject to challenge under the per se rule." This is an important reason why standard setting organizations often carefully avoid talking about royalties and why patent pools, if they are formed at all, are often formed rather late in the standardization process.

The preceeding sections have shown that patent pools can play an important role in lowering royalties, reducing transaction costs, disseminating new technologies, and fostering innovation incentives. However, due to the free rider problem in pool formation, the larger

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[9] See Gilbert (2004) for a historical review of the role of patent pools in the U.S. economy.

[10] US Department of Justice and Federal Trade Commission (1995), "Antitrust Guidelines for the Licensing of Intellectual Property", April 6, 1995, available at http://www.justice.gov/atr/public/guidelines/0558.pdf .

the number of essential patent holders the more difficult it is to establish a pool that comprises all essential patents. Thus, we are probably seeing less and smaller patent pools than would be socially optimal.

Competition authorities should not only tolerate patent pools but actively encourage them, provided that pools allow for independent licensing outside the pool and require grantbacks. These safeguard are necessary to make sure that the pool is not used to suppress competition between patents that are substitutes and that follow-up innovations cannot be used to block the pool. With these safeguards in place there is little risk that patent pools are anti-competitive.

Patent pools are not just a means to solve the complements problem, they can also be used to mitigate the free rider problem in innovation incentives. However, this requires that pools are formed at an early stage of the standardization process. The combination of high royalties and grantback provisions can give powerful investment incentives, in particular when these royalties are renegotiated after investments are made. Thus, competition should be more lenient towards early pools, even if they set royalties that seem higher than socially optimal.

A second suggestion is to adopt a system of "full functionality approval". Because each patent holder wants to free-ride on the low royalties set by the other patent holders who stay in the pool, many pools do not form or do not include all essential patents. "Full functionality approval" can help to solve this problem by making every patent holder pivotal. Each patent holder knows that without his cooperation a pool cannot be sustained and everybody will charge royalties non-cooperatively. This increases the incentives to disclose all relevant patents and to join the pool.

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5 When Standards Require IP: FRAND v. Negotiation

Richard Gilbert[*]

5.1 Introduction

Standards sometimes specify technologies whose use would infringe on proprietary intellectual property rights. If firms and consumers make investments that are specific to the standard and cannot easily switch to an alternative that is a close substitute for the standard, owners of these intellectual property rights (typically patents) may have the ability to "hold up" consumers and firms by charging high royalties for their proprietary rights.

Firms that invest to develop and patent new technologies face a different type of potential hold-up. These firms have sunk research and development expenditures when members of a standard development organization (SDO) consider their technologies for inclusion in a standard. If rights owners have limited alternative uses for their intellectual property, licensees may be able to negotiate royalties that do not adequately compensate rights holders for their invention efforts.

Some standard development organizations (SDOs) have attempted to balance the legitimate desire to earn royalty revenues with concerns about post-standardization hold-up by requiring owners of patents whose use would be required to comply with a standard to disclose the existence of the patents and to commit to license

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their patents at terms that are fair, reasonable, and nondiscriminatory (FRAND). Neither SDOs nor the courts have defined the contours of FRAND licensing terms (Lemley, 2002). This ambiguity has led the membership of some SDOs to consider negotiation of licensing terms for patents that are essential to make or use products that comply with a standard prior to the issuance of the standard.

SDOs have avoided collective discussions of licensing terms by their members out of concern for potential antitrust exposure. This differs from independent bilateral negotiations between rights holders and potential licensees, which generally do not raise antitrust concerns. I refer to coordinated discussions between members of an SDO and rights holders as joint negotiation of licensing terms.

The U.S. Antitrust Division noted that it would apply a rule of reason framework to joint negotiation of licensing terms (Barnett 2007). The Antitrust Division and the U.S. Federal Trade Commission affirmed this guidance in subsequent speeches and publications (Majoras, 2005, U.S. Department of Justice and Federal Trade Commission, 2007). Draft guidelines issued by the European Commission state that "should a standard-setting organisation's IPR policy require, or allow, IPR holders to individually disclose their most restricttive licensing terms, including the maximum royalty rates they would charge, prior to the adoption of the standard this will not lead to a restriction of competition within the meaning of Article 101(1) as long as the rules do not allow for the joint negotiation or discussion of licensing terms in particular royalty rates." (European Commission, 2010)

Joint negotiation raises concerns about the coordinated exercise of monopsony power[1] when members of the SDO are primarily

[1] In what follows, I use the term "monopsony power by a SDO" to refer to the collective exercise of monopsony or oligopsony power by members of the SDO.

technology users rather than technology suppliers.[2] A less restrictive alternative is to rely on bilateral negotiations between potential licensees and rights holders along with a clear non-discrimination requirement (i.e., the ND prong of FRAND).[3] Preventing undue discrimination between similarly situated licensees assures technology adopters that they will gain the benefits of licensing terms negotiated before firms and consumers make investments that are specific to a standard. This alternative policy will require SDOs or the courts to better define the meaning and requirements of non-discrimination in a technology licensing context.

5.2 Market Power in Royalty Negotiations

Figure 1 describes the textbook approach to the evaluation of buyer (monopsony) power. The buyer faces an upward-sloping supply curve. The supply curve describes the price of a product if the buyer is a consumer or the cost of an input if the buyer is a firm that uses the input to manufacture a product. The buyer exercises monopsony power by equating its marginal willingness to pay for the product or input to the marginal revenue cost of the product or input.

For a firm, the marginal willingness to pay for an input is its marginal revenue product, which is the additional revenue from the

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[2] Concerns about hold-up are diminished if rights holders are vertically integrated firms whose objectives are to make and sell products rather than obtain royalties for their patents (see, e.g. Teece and Sherry, 2003, Gilbert, forthcoming , Layne-Farrar, forthcoming, Schmidt, forthcoming). However, many rights holders are inventors whose priority is to earn revenues from their patents.

[3] See Gilbert (2010) for a further elaboration of bilateral negotiation with non-discrimination as an alternative to FRAND commitments for the mitigation of possible market power from standardization.

use of another unit of the input. The marginal revenue cost is the price of the last unit purchased of the input plus the effect of another unit of demand on the cost of all the other units of the input purchased by the firm. More precisely, let Q be a firm's demand for an input and let $w(Q)$ be its price. The total cost is $Qw(Q)$. The marginal revenue cost is $MRC(Q) = w(Q) + Qdw(Q)/dQ$. If the supply curve is upward-sloping, then $dw/dQ > 0$ and $MRC(Q) > w(Q)$. The firm equates the input's marginal revenue cost to its marginal revenue product. If there are no other significant sources of demand for the input, and if its cost is upward-sloping, this will depress the utilization of the input below its efficient level, which corresponds to the level at which the price of the input, $w(Q)$, equals the marginal revenue product from another unit of the input.

Figure 1 shows the efficient utilization of the input, Q^*, and the monopsony utilization of the input, Q^m. The vertical axis in Figure 1 measures the unit cost, the marginal revenue cost, and the marginal revenue product as a function of the utilization of the input. The input price w^* is its market price when the input is used at the efficient level. The price w^m corresponds to the input utilization for which the marginal revenue cost is equal to the marginal revenue product. If the input cost increases with utilization, then $w^m < w^*$.

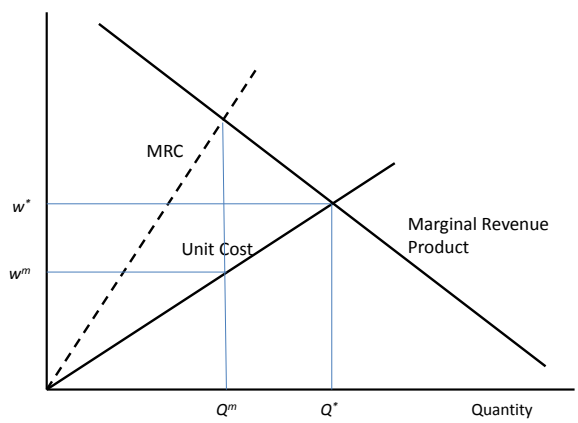

Figure 1. Monopsony with upward-sloping supply.

The textbook model does not apply to joint negotiations by members of a SDO for proprietary patent rights. First, the SDO is not a buyer of the rights for any technology, although there is a sense in which a SDO that develops a standard specification is acting as an agent of consumers of the standardized technologies and the firms that employ the standard in their products. In this respect the members of the SDO can be viewed as buyers of proprietary rights that cover technologies invoked by a standard.

Second, the "supply curve" for a patent is essentially flat. Excluding any royalty, the cost of a patent is zero or close to zero and does not increase appreciably with additional units that employ the patent. While the total marginal cost of a technology that employs the patent may increase with the number of units supplied due to other scarce factors, the direct cost of the patent is negligible exclude-ing any royalty for its use. Therefore, the buyer has no incentive to lower the cost of the patent by reducing the utilization of the patented technology.

Although the marginal cost of a patent, excluding any royalty, does not increase with the number of licensed units, there is still scope for the exercise of monopsony power. Let MC_1 be the marginal cost of the technology that uses the proprietary intellectual property under the assumption that there is no royalty for the use of the patent and there are no other scarce factors that cause the marginal cost to increase with use. Ex ante, before a standard has been specified, suppose there is another available technology with a marginal cost MC_2 including the cost of any proprietary rights that are necessary to use this technology. Members of the SDO, acting as agents of consumers and firms, should offer a royalty that is no more than $R = MC_2 - MC_1$ for the licensed technology. However, they may pay a good deal less.

Figure 2 shows the marginal cost MC_1 of supplying a product using the patent when the patent has no royalty. Given that MC_1 is independent of Q, it follows that $MRC_1(Q) = MC_1$. If the patent has a per-unit royalty R, then the total marginal cost of the technology is $MC_1 + R$. This is also shown in Figure 2. The figure also shows the marginal cost of the alternative technology, MC_2, which is also assumed to be independent of use.

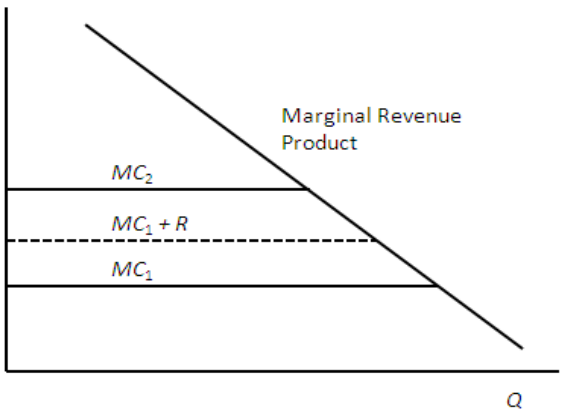

Figure 2. Marginal revenue product and marginal costs of alternative technologies.

In evaluating arrangements that limit opportunistic conduct, a basic question is the appropriate competitive benchmark for the royalty, R. Under "perfect competition," the royalty rate would equal the marginal cost of licensing the patent, which is zero. Clearly, a royalty of zero offers no incentive for research and development and cannot be dynamically efficient. It also does not approximate a market outcome, which involves negotiations between technology users and the patent rights holder, all of whom have some market power.

Joint negotiation by members of a SDO could depress the patent royalty below the level that would result from market competition in the absence of switching costs and, a fortiori, below $R = MC_2 - MC_1$, which would make the cost of the superior technology equal to its

next-best alternative. This depression is an exercise of monopsony power.[4]

5.3 A Bargaining Model of Ex ante Joint Negotiation

A simple bargaining model illustrates the consequences of ex ante joint negotiation by members of a SDO that act as agents of firms that develop products using the standardized technology. Inputs into the bargaining model include the value of a technology to licensees and the reservation value of the licensor. Let V represent the per unit revenue that each firm can earn by manufacturing products that are covered by the standard. Ex ante, before firms and consumers make investments that are specific to a standard, there are two alternative technologies that firms can use to manufacture these products. Technology 1 requires rights to a patent and allows production at marginal cost MC_1 plus the cost of the patent royalty. Technology 2 allows production at constant marginal cost MC_2 and requires no proprietary patent rights. Ignoring the royalty for technology 1, $MC_1 < MC_2 < V$. Bargaining is over the per-unit royalty for the patent that is essential to use technology 1.

The next-best alternative technology establishes a reservation value for the members of the SDO acting collectively as agents for

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[4] Under some restrictive assumptions, $R = MC_2 - MC_1$ is the outcome of a hypothetical auction in which technology owners bid for adoption by a SDO, as suggested by Swanson and Baumol (2005). It is also the outcome of Nash-Bertrand competition among technology sponsors when there is a well-defined marginal cost associated with the use of each technology. See Farrell et al. (2007). It is often the case that many patented technologies are essential to allow production with a particular value or marginal cost. In that case there is no clear rule to allocate value to the different patents. See e.g., Layne-Farrar et al. (2007).

users of the standardized technology. The SDO members collectively can obtain a value of $V\text{-}MC_2$ per unit of product that employs the standard. By assumption, this reservation value is greater than zero. The patented technology allows users of the standard to achieve a value of $V\text{-}MC_1$, less the per-unit royalty for the patent. Therefore, members of the SDO, acting on behalf of technology users, would not accept a per-unit royalty that is greater than $R = MC_2\text{-}MC_1$, as this would result in a value for the patented technology that is less than the value of the alternative technology.

In addition, the patentee may have a use for the patented technology that would guarantee a payoff of R_0 per licensed unit. This payoff is a reservation value for licensing if it can be achieved only as an alternative to the standard under negotiation. That is, if the patentee can pursue an alternative path for use of its patent that precludes the use of the patent in the proposed standard, then the payoff from this alternative establishes a floor for the royalty that the patentee would accept in its negotiations with members of the SDO.

Summarizing, key inputs into the model are:

Technology users' reservation value per unit	$V - MC_2$
The patentee's reservation value per unit	R_0
The per-unit royalty for the patent	R
Technology users' value of the patented technology	$V - MC_1 - R$

The gain from trade for the patentee and the members of the SDO is the difference between the total payoffs with a license and the total payoffs without a license. This is

$$\Delta W = [(V - MC_1 - R) + R] - [(V - MC_2) + R_0].$$

The first term in brackets is the total payoff per licensed unit from successful negotiation with the SDO, which equals the net payoff to the members of the SDO ($V - MC_1 - R$) plus the net payoff to the

patentee (R). The second term in brackets is the sum of the reservation values of the SDO (V - MC_2) and the patentee (R_0). Thus

$$\Delta W = MC_2 - MC_1 - R_0.$$

With efficient bargaining, the members of the SDO and the patentee will conclude a license if and only if the gain from trade is positive. This requires $MC_2 - MC_1 > R_0$.

Following the Nash bargaining model, the royalty for the patented technology is equal to the patentee's reservation value plus a share, θ, of the gain from trade.

$$R^J = R_0 + \theta^J(MC_2 - MC_1 - R_0),$$

which is equivalent to

$$R^J = (1-\theta^J)R_0 + \theta^J(MC_2 - MC_1). \quad (1)$$

The superscript "J" indicates that this is the royalty outcome from joint negotiation with the members of the SDO before firms and consumers make investment that are specific to a standard that includes the patented technology. The share θ is a measure of the relative bargaining power of the SDO members and the patentee. A value of θ close to one indicates that the patentee has the power to obtain most of the gain from trade, while a value close to zero indicates that the members of the SDO, acting collectively, can force the patentee to accept little more than its reservation value R_0.

If the patentee has no viable alternatives, R_0 would be zero in the bargaining that takes place between the patent holder and the members of the SDO. As a result, joint negotiation by the SDO's members would hold the patentee's royalty to a fraction of its contribution to value, which is the difference MC_2 - MC_1. Furthermore, this fraction would be very small if the members of the SDO are aggressive bargainers, corresponding to a low value for θ. That is, R^J, the outcome of ex ante joint negotiation, would be close to zero.

5.4 Ex post Bilateral Bargaining

Proponents of ex ante joint negotiation argue that it has efficiency benefits relative to ex post negotiation. Ex post negotiation occurs after firms and consumers have made investments that are specific to a standard. These specific investments are a cost that is sunk for the standardized technology but would have to be incurred anew to switch to an alternative technology. In addition, ex post negotiation is not conducted jointly by technology adopters, but typically occurs bilaterally between the patent holder and potential licensees.

I illustrate the consequence of ex post bilateral bargaining assuming two potential licensees, A and B. These licensees are competitors in the product market that employs the licensed technology or its alternative. As before, the patented technology allows production with marginal cost MC_1 and there is an alternative that allows production with marginal cost $MC_2 > MC_1$. In addition, adoption of the alternative technology requires specific investments in the amount S. While this is a fixed cost, for convenience I measure this cost on a per-unit basis.

An additional important complication in bilateral bargaining is that the per-unit payoff to each potential licensee depends not only on whether it accepts a license, but also on whether its competitor accepts a license and on the terms that the patentee offers to both potential licensees. I evaluate bilateral bargaining under the assumption that the licensee can threaten to license exclusively to either A or B. This can be accomplished by either an exclusive license or by charging one of the firms a royalty that is so high as to make the firm an ineffective competitor.

Consider the offer of an exclusive license to A with pre-unit royalty R^A. If A accepts the license, it has a net per-unit value

$$W^A = V^A - MC_1 - R^A.$$

Here V^A is the per-unit value that A can earn from the use of the patented technology when it is the exclusive licensee.

If A rejects the license it has a net per-unit value

$$W_0^A = max\ [V_0^A - MC_2 - S; 0],$$

where S is the per-unit cost required to invest in the alternative technology and V_0^A is the value that A can earn from use of the alternative technology when B accepts a license from the patentee. For example, if A and B are Nash-Bertrand competitors in a homogeneous product market, then $V_0^A = 0$ if $MC_1 + R^B < MC_2$, because B would undercut any profitable price charged by A. More generally, I assume that $0 < V_0^A < V^A$.

The patentee has a reservation royalty R_0^A that sets a floor for the royalty it would accept to license its patent to A. The reservation royalty is no less than what the patentee could earn by entering into an exclusive license with B.

If the patentee enters into negotiations for an exclusive license, the gain from trade is

$$\Delta W = V^A - MC_1 - max\ [V_0^A - MC_2 - S; 0] - R_0^A.$$

The negotiated royalty is

$$R^A = (1-\theta)R_0^A + \theta(V^A - MC_1 - max\ [V_0^A - MC_2 - S; 0]). \qquad (2)$$

The patentee has a credible threat to offer an exclusive license to B. Thus the patentee's reservation royalty for negotiations with A, R_0^A, equals the royalty it can earn from an exclusive license with B. If the two licensees are otherwise identical, then it must be the case that

$$R_0^A = (1-\theta)R_0^A + \theta(V^A - MC_1 - max\ [V_0^A - MC_2 - S; 0]).$$

Hence

$$R_0^A = V^A - MC_1 - max\ [V_0^A - MC_2 - S; 0]$$

and the bargaining outcome with an offer of exclusivity to two identical potential licensees is

$$R^A = V^A - MC_1 - max\ [V_0^A - MC_2 - S; 0] \qquad (3)$$

Exclusivity allows the patentee to capture all of the net gain from an exclusive license when the licensees are identical. This is also the

outcome of a hypothetical auction market in which licensees bid for an exclusive license.

Alternatively, the patentee could choose to license both A and B. If both A and B accept a license, they each earn V^{AB} per unit. If A refuses a license, its payoff using the alternative technology is

$$W_0^{AB} = max\ [V_0^A - MC_2 - S; 0] = W_0^A.$$

If A refuses a license to technology 1, its alternative payoff is what it can earn by switching to the alternative technology 2 when B has a license to technology 1. This is the same reservation payoff that A would have if it rejects an exclusive license to technology 1.

The negotiated royalty with bilateral bargaining when the patentee offers a license to both A and B is

$$R^{AB} = (1-\theta)R_0^{AB} + \theta(V^{AB} - MC_1 - max\ [V_0^A - MC_2 - S; 0]). \qquad (4)$$

The patentee would offer a license to both A and B if

$$R^{AB} = (1-\theta)R_0^{AB} + \theta(V^{AB} - MC_1 - max\ [V_0^A - MC_2 - S; 0]) >$$

$$R^A = V^A - MC_1 - max\ [V_0^A - MC_2 - S; 0].$$

The patentee's reservation value when it offers a non-exclusive license to both A and B is zero if it does not have an alternative use for the patent. In that case, a necessary condition for the patentee to offer licenses to both A and B instead of offering an exclusive license to only A or B is that $V^{AB} > V^A$. However, this is not a sufficient condition because the patentee likely has less bargaining power when it cannot threaten to license exclusively. The patentee would offer an exclusive license if

$$V^A - MC_1 - max\ [V_0^A - MC_2 - S; 0] > \theta(V^{AB} - MC_1 - max\ [V_0^A - MC_2 - S; 0]).$$

Even if the gain from licensing is larger when both A and B have a license, the patentee may choose to offer an exclusive license because it can capture a larger share of the licensing surplus; *i.e.*, $\theta < 1$. For the purpose of comparisons to alternative licensing arrangements, I assume that $R^A > R^{AB}$.

Compared to ex ante joint negotiation, bilateral bargaining results in higher royalties for two reasons. First, if the bargaining is ex post, after firms and consumers have made investments that are specific to the standard, then the licensor can appropriate some or all of the costs of switching to an alternative technology, S. Second, by threatening to offer an exclusive license to a competitor, the licensor can appropriate a greater share of the gain from trade, and possibly all of the gain from trade if the two licensees are identical.

Figure 3 shows the outcomes with ex ante joint negotiations and ex post bilateral bargaining under the assumption that $\theta = .25$ and $R_0 = 0$, reflecting substantial bargaining power by the SDO. The figure shows marginal production costs with ex ante joint negotiation and with ex post bilateral bargaining and exclusive licensing. In both cases, the marginal cost is $MC_1 + R$, where R is the negotiated royalty. Thus, with ex ante joint negotiation, the marginal cost is $MC_1 + .25(MC_2 - MC_1)$. With ex ante joint negotiation and exclusive dealing, the marginal cost is $V^A - max\ [V_0^A - MC_2 - S; 0]$.

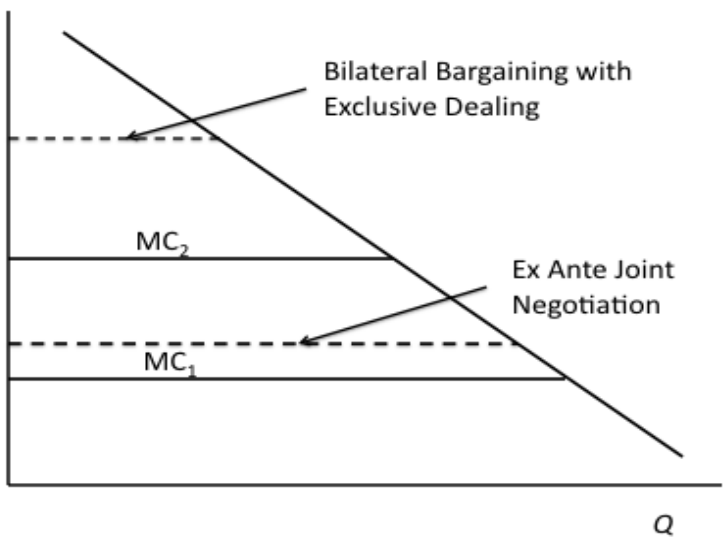

Figure 3. Outcomes under alternative bargaining assumptions.

Figure 3 presents a choice of two undesirable outcomes. With ex ante joint negotiation, the royalty is too low to encourage efficient investment in R&D. With ex post bilateral bargaining, the royalty is higher than the patented technology's contribution to value. The question to which we now turn is whether there are alternative licensing arrangements that achieve a reasonable middle ground.

5.5 Bilateral Bargaining with Non-Discrimination

Proposals to allow ex ante joint negotiation of licensing terms by members of a SDO are in part a response to limitations of other measures, in particular, commitments by technology rights holders to license intellectual property that may be essential to use of standard at terms that are "fair, reasonable and non-discriminatory" (FRAND). No court or enforcement agency has established a workable definition for licensing terms that are "fair and reasonable". In contrast, the "non-discrimination" prong of a FRAND commitment is amenable to a workable definition. The combination of a clear non-discrimination requirement and ex ante bilateral bargaining can be a useful and less restrictive alternative to ex ante joint negotiation for most standardization efforts.

Ex ante bilateral negotiations protect those who make binding agreements with rights holders. But those who do not negotiate ex ante, including firms and consumers that enter the industry after a standard has issued, do not have the protection of licensing agreements settled ex ante and may be exposed to opportunistic conduct ex post. The non-discrimination prong of a FRAND commitment provides an umbrella of protection for technology users that negotiate licenses after firms and consumers have made investments that are specific to a standard as well as for users that have little bargaining power to negotiate royalties ex ante.

Non-discrimination requires uniform treatment for similarly situated licensees, but it does not have to be interpreted rigidly. Some flexibility in licensing terms is desirable (Willig, 1978). A

reasonable interpretation of the non-discrimination requirement of FRAND is that all licensees should be able to choose from the same schedule of royalties, which may be a single fixed fee, a fixed per-unit running royalty, or a royalty that declines with output. It also can be pro-competitive to offer a choice of licensing terms, because licensees will choose the combinations of price and quantity that give them the highest values.

Consider how bargaining changes with the imposition of a non-discrimination constraint. First, note that if patents are disclosed prior to standardization, it is likely that bilateral bargaining will take place between rights holders and potential licensees before a standard has been specified. In that event, bargaining can occur in the absence of switching costs. Furthermore, if non-discrimination requirements extend over time, the bargaining that occurs ex ante is likely to constrain royalties ex post, after firms and consumers have made investments that are specific to a standard.

Again, consider two potential licensees, A and B that are competitors in the product market that employs the licensed technology or its alternative. If A accepts a license with royalty R^A, it has a net per-unit value

$$W^A = V^{AB} - MC_1 - R^A.$$

Here V^{AB} is the per-unit value that A can earn from the use of the patented technology when both A and B accept a license.

If A rejects the license, its payoff depends on what effect its rejection has on the decisions of other licensees (B in this example). If the choice of a standard requires support from A, then A is said to be pivotal to the adoption decision. In that case, if A rejects a license, B will do the same. When A (or B) is pivotal to the adoption decision, and the decision occurs prior to standardization, then the licensee's reservation value is the same as in the case of ex ante joint negotiation. Furthermore, if A or B is pivotal and if the firm knows

that its consent is pivotal to the adoption of a technology in a standard, then the outcome of ex ante bilateral bargaining with non-discrimination is similar to the outcome of ex ante joint negotiation.[5] The negotiated royalties may differ, however, to the extent that the bargaining power of a pivotal adopter, as measured by its share of the gain from licensing, differs from the bargaining power of members of a SDO acting jointly.

If A is not pivotal to the decision to include the patented technology 1 in a standard, or if A is unaware of its central role in the standardization decision, then its reservation value depends on whether it can adopt the alternative technology without incurring a switching cost. If it can avoid a switching cost, its reservation value is

$$W_0^A = max\ [V_0^{AB} - MC_2; 0],$$

where V_0^{AB} is the value that A can earn from use of the alternative technology when B accepts a license from the patentee.

When adoption of a standard has significant network externalities or leads to large economies of scale, then A could not switch to the alternative technology if it chooses not to accept a license to technology 1 without incurring a per-unit switching cost, S. In that case, A's reservation value would be

$$W_0^A = max\ [V_0^{AB} - MC_2 - S; 0].$$

When there are large network effects or scale economies, the outcome of ex ante bilateral bargaining with non-discrimination is similar to the outcome with ex post bilateral bargaining with the important qualification that the patentee cannot choose to license exclusively to A or B. As noted above in the discussion of ex post

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[5] See Layne-Farrar, Llobet, and Padilla (2009). Segal and Whinston (2000) provide a general analysis of the effects of pivotal buyers in the context of exclusive dealing arrangements.

bilateral bargaining, the negotiated royalty when the patentee offers licenses to both A and B is likely to be lower than the negotiated royalty when the patentee can license A or B exclusively. Indeed, the mere threat of offering an exclusive license, if credible, can signify-cantly increase the patentee's share of the surplus from a license.

A non-discrimination requirement is similar in some respects to a most-favored-customer (MFC) clause in a contract, under which a customer is assured that its price will be no higher than the lowest price paid by any another customer.[6] If the seller negotiates a lower price with another customer, it is obligated to refund the difference to the customer with the MFC clause. In theory, MFC provisions discourage price-cutting and can lead to higher equilibrium prices (Cooper, 1986, Edlin, 1997). As with a most-favored customer commitment, a non-discrimination commitment can discourage dis-counting and, as a consequence, may lead to higher royalties com-pared to licensing arrangements that allow different royalties for licensees.

Suppose there are no pivotal licensees, or none who are aware of their central importance to the adoption of a technology in a standard, and assume that network effects or scale economies make switching to a different technology prohibitively expensive. Further-more, assume that the patentee's reservation value of licensing with non-discrimination is zero. Then, from equation (3) and (4), the difference between the negotiated royalty with and without the non-discrimination requirement is

$$R^{AB} - R^{A} = \theta(V^{AB} - MC_1) - (V^{A} - MC_1) = \theta(V^{AB} - V^{A}) - (1- \theta)(V^{A} - MC_1) \quad (5)$$

The non-discrimination requirement results in a lower royalty if V^{AB} is not too much larger than V^{A}. Furthermore, it is socially desirable to

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[6] A MFC commitment is not equivalent to non-discrimination because it does not necessarily apply to every customer and it does not prevent more advantages terms for those customers that have a MFC commitment.

license both A and B if V^{AB} exceeds V^{A}. In that case, the non-discrimination requirement would have social benefits if it forces the patentee to license non-exclusively when it might not otherwise do so.

While it is not possible to determine the outcomes of alternative licensing environments precisely, it is likely that the royalty outcome corresponding to ex ante bilateral bargaining and non-discrimination is between the royalty outcomes corresponding to ex ante joint negotiation and ex post bilateral bargaining. If so, then ex ante bilateral bargaining and non-discrimination allows patentees to obtain a return on their investments, while limiting the ability of patentees to extract additional royalties from switching costs related to standardization.

5.6 Concluding Remarks

The combination of ex ante bilateral bargaining and a clear non-discrimination commitment can provide protection from ex post opportunistic conduct without the risk of abuse of monopsony power that may occur with joint negotiation of licensing terms by the members of a SDO. The non-discrimination commitment extends the bargaining power of influential technology adopters to other industry participants, including other members of a SDO and firms that may seek licenses after a standard issues and firms and consumers make investments that are specific to the standard. However, implementation of bilateral bargaining with non-discrimination would require enforcement agencies or the courts to develop a definition of non-discrimination that does not unduly constrain patentees and licensees from designing efficient licensing terms.

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6 Reverse Hold-ups: The (Often Ignored) Risks Faced by Innovators in Standardized Area

Damien Geradin[*]

6.1 Introduction

There is an abundant economic and legal literature on the interface between intellectual property and standardization. Following the footsteps of Mark Lemley and Carl Shapiro,[1] the bulk of this literature (the "hold-up literature") focuses on the risks of patent "hold-up" faced by firms implementing standards involving intellectual property rights ("IPRs") by manufacturing standard-compliant products.[2]

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[1] Marc Lemley & Carl Shapiro, "Patent Holdup and Royalty Stacking", 85 (2007) *Texas Law Review* 1989. See, however, John Golden's response (John M. Golden, "Patent Trolls' and Patent Remedies", (2007) 85 *Texas Law Review* 2111) and Lemley and Shapiro's reply to John Golden (Mark Lemley & Carl Shapiro, "Reply: Patent Holdup and Royalty Stacking", (2007) *85 Texas Law Review* 2163).

[2] Thomas F. Cotter, "Patent Holdup, Patent Remedies, and Antitrust Responses", 34 (2009) *Journal of Corporation* Law 1151; Philippe Chappatte, "FRAND Commitments – The Case for Antitrust Intervention", (2009) 2 *European Competition Journal* 319; George S. Cary, Larry C. Work-

This "hold-up" conjecture is usually described as follows.[3] Once a standard has been adopted and manufacturers or users of standard-compliant equipment have incurred significant technology-specific sunk costs, switching to an alternative technology becomes too onerous. The industry in question will have become "locked-in" to the standard. The bargaining power of the owner of essential IPR will have thus increased as a result of standardisation and he will be able to extract more favourable licensing terms after standardisation than would otherwise have been the case.

The patent hold-up conjecture is thus a claim that, due to the market power gained through standardization, essential patent holders are able to negotiate royalties in excess of their true economic contribution and are thus over-rewarded. Others, including the author of this paper, have, however, argued that the alleged risks of patent hold-up have been grossly exaggerated in this literature by ignoring the significant constraints faced by essential patent holders

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Dembowski, & Paul S. Hayes, "Antitrust Implications of Abuse of Standard-Setting", (2008) 15 *Geo. Mason L. Rev.* 1241; Joseph Farrell et al., 'Standard Setting, Patents, and Hold-Up', (2007) 74 Antitrust Law Journal 603; See Maurits Dolmans, "Standard Setting – The Interplay With IP And Competition Laws – How to Avoid False FRANDs", paper presented at the 2008 Fordham IPR Conference, p. 13.

[3] In addition to patent hold-up, the same authors have claimed that that when a good is comprised of multiple complementary components, each of which is necessary for production and covered by patents held by separate firms, the aggregate royalty fees for licensing all of the required essential patents can then add up to a level that is so high that it could compromise the implementation of the standard ("royalty stacking"). See Lemley and Shapiro, supra note 1. But see, Damien Geradin et al., "The Complements Problem within Standard Setting: Assessing the Evidence on Royalty Stacking", (2008) 14 *Boston University Journal of Science & Technology Law* 144 (showing that there is little empirical evidence of royalty stacking).

and the very limited set of circumstances in which hold-up can occur.[4]

Another problem with the hold-up literature is that, while it exaggerates the risks incurred by standard implementers, it entirely ignores the risks faced by innovators active in standardized fields. As will be shown in this paper, holding patents on valuable technologies does not by any means guarantee the innovator that it will be able to recoup its sunk R&D investments as it faces significant, and increasingly growing, risks. First, innovators have no guarantee that, however valuable, their technology will be selected to be part of the relevant standard(s). Technology selection is competitive and will be increasingly so now that "costs" considerations are taken into consideration. Second, even if their technology is selected, innovators have to negotiate with standard implementers, which as will be seen below are seeking through various means, including the exercise of monopsony power,[5] to reduce the royalty payments they make to

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[4] Damien Geradin and Miguel Rato, "FRAND Commitment and EC Competition Law: A Reply to Philippe Chappatte", (2010) 6 *European Competition Journal* 129 (hereafter, "FRAND Commitment and EC Competition Law"); Damien Geradin, "Pricing Abuses by Essential Patent Holders in a Standard-Setting Context: A View from Europe", (2009) 76 *Antitrust Law Journal* 329 (hereafter, "Pricing Abuses by Essential Patent Holders in a Standard-Setting Context"); Damien Geradin & Miguel Rato, "Can Standard-Setting Lead to Exploitative Abuse? A Dissonant View on Patent Hold-up, Royalty-Stacking and the Meaning of FRAND", (2007) 3 *European Competition Law Journal* 101 (hereafter, "Can Standard-Setting Lead to Exploitative Abuse?").

[5] See e.g., Gil Ohana, Marc Hansen & Omar Shah, "Disclosure and Negotiation of Licensing Terms Prior to Adoption of Industry Standards: Preventing Another Patent Ambush", (2003) 24 *European Competition Law Review,* 644; Robert A. Skitol, "Concerted Buying Power: Its Potential for Addressing the Patent Holdup Problem in Standard Setting, (2005) 72

innovators. Third, standard implementers and their supporters are pushing for reforms that would weaken the bargaining power of essential patent holders, notably by depriving them of the ability to seek injunctive relief[6] or by reinterpreting the definition of the commitment they give to SSOs to grant licenses on "fair, reasonable and non-discriminatory" (FRAND) terms in a manner that is unfavourable to them.[7] Finally, as illustrated by recent competition law cases, innovators also face growing regulatory risks as implementers may seek to use competition rules to force royalties and other licensing terms down on the ground they would be contrary to FRAND, exploitative under the terms of Article 102 of the Treaty on the Functioning of the European Union (TFEU),[8] etc.

By exploring these risks, which may – as will be argued – may create "reverse patent hold-ups" (in that essential patent holders instead of being over-compensated will in fact be under-compensated by being forced to accept royalties that are lower than the value of the contribution of their technologies to a standard), this paper seeks to fill an important gap in the current standard-setting literature and give a more accurate perspective on the challenges facing innovators in standardized fields.

This paper comprises 5 parts. Part 6.2 provides some background on SSOs involving technologies protected by IPRs and the IPR

Antitrust Law Journal, 727. But see J. Gregory Sidak, "Patent Holdup and Oligopsonistic Collusion in Standard-Setting Organizations", (2009) 5 *Journal of Competition Law & Economics* 133.

[6] See, e.g. Joseph Miller, "Standard Setting, Patents, and Access Lock-in: RAND Licensing and the Theory of the Firm", (2007) 40 *Indiana Law Review* 351.

[7] See Chappatte, supra note 2; Dolmans, supra note 2.

[8] See infra, text accompanying notes 71-76.

policies they traditionally adopt. Part 6.3 describes the patent hold-up conjecture as developed by its supporters and shows that the risks it creates for standard implementers and users of standardized products are grossly exaggerated. Part 6.4 shows that, in contrast to the claims made by patent holdup theorists, innovators active in standardized fields face significant risks of being under-compensated and thus could become the victims of reverse hold-ups. Part 6.5 offers a conclusion in which it is explained that the efforts made by standard implementers to constrain the abilities of essential patent holders to generate revenues will harm innovation and prevent efficient specialization by particularly affecting firms that have a licensing business model.

6.2 Background on the SSOs involving technologies protected by IPRs

Before going any further in our analysis, it is important to briefly discuss the traditional IPR policies adopted by SSOs (Section A), as well as the strategic battles taking place inside these organisations (Section B).

A. Traditional IPR policies adopted by SSOs

Standards typically include technologies protected by IPRs. An IPR entails an exclusive right, allowing its owner to prevent any third party from applying or using what is protected by this right. Except in certain exceptional circumstances,[9] a patent owner may therefore

[9] The ECJ, for instance, has held that such exceptional circumstances may occur where the refusal to license cannot be objectively justified and would eliminate all competition, in a downstream market, for a new product for which there is customer demand not offered by the owner of the IPR. See

decide not to grant any third party a licence to practice the invention. SSOs cannot thus force a patent owner to grant a licence. Patented technology that becomes part of a standard can only be used by third parties if the patent owner is willing to grant a licence. For instance, the European Telecommunications Standards Institute (ETSI)'s IPR policy does not contain any obligation to license essential IPR. Rather, it provides that a standard or specification may not be approved unless the owner of essential IPR provides an assurance of its licensing intentions.[10]

The question as to what "fair and reasonable" terms are goes back to the second prerogative of the patent owner, i.e. its right to be rewarded for the innovative contribution made. Again, the standardization process and the FRAND commitment typically made by

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inter alia Case 238/87 *Volvo* 1989 4 CMLR 122, para. 8; Joined Cases C-241/91 P and C-242/91 P *RTE and ITP* v *Commission* ('*Magill*') [1995] ECR I-743, para. 50; Case C-418/01 *IMS Health GmbH & Co. OHG v NDC Health GmbH & Co. KG*, paras. 35 and 52. See Damien Geradin, "Limiting the Scope of Article 82 of the EC Treaty: What can the EU Learn from the US Supreme Court's Judgment in *Trinko* in the wake of *Microsoft*, *IMS*, and *Deutsche Telekom*", 41 (2004) *Common Market Law Review* 1519.

[10] Section 6.1 of ETSI's IPR Policy provides that when essential IPR is disclosed, ETSI will request – but not oblige – the owner of the IPR to undertake in writing that it is prepared to grant irrevocable licences on FRAND terms and conditions, and as such to waive its right to refuse to offer a license to those seeking such. Likewise, if the owner of an essential IPR decides not to subscribe to a FRAND commitment, it does not necessarily follow that the relevant IPR will be excluded from the standard. Under Article 8.1 of ETSI's IPR Policy ETSI's General Assembly will examine whether alternate technical solutions exist. Where it concludes that this is not the case, the Director General may request the owner of the IPR to reconsider. However, the latter is not under an obligation to agree to license.

essential patent holders do not deprive a patent owner from this prerogative. The specific terms of any licence, however, are left to the parties to the negotiation, which is taking place outside the SSO. For example, ETSI makes clear that such discussions will not take place under its standard development activities, as it takes the view that its role is directed to technical rather than commercial issues. The "fair and reasonable" and "non-discriminatory" character of any licence must be addressed in a commercial context outside the standard-setting environment.[11]

A FRAND commitment is thus to ensure that any standard adopted remains available for implementation by all companies willing to take advantage of the opportunity to negotiate and enter into a licence agreement.[12] However, it does not impose any form of price control or limitation on the licensor, nor an obligation to license on disadvantageous conditions. On the contrary, FRAND means that royalty rates should be determined through fair, bilateral negotiations in accordance with market conditions.

B. Asymmetries of interests between members of SSOs

Issues, such as the interpretation of FRAND or the appropriateness of imposing limitations on the level of royalties that can be

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[11] ETSI Guide on IPRs, Section 4.1 (""Specific licensing terms and negotiations are commercial issues between the companies and shall not be addressed within ETSI. Technical Bodies are not the appropriate place to discuss IPR issues. Technical Bodies do not have the competence to deal with commercial issues. Members attending ETSI Technical Bodies are often technical experts who do not have legal or business responsibilities with regard to licensing issues. Discussion on licensing issues among competitors in a standards making process can significantly complicate, delay or derail this process.")

[12] Such as was the situation in the *Magill/IMS* cases, see supra note 9.

charged by essential patent holders, are hotly debated and there is little consensus among stakeholders. To better understand why the debate is polarized it is helpful to distinguish between the following distinct categories of SSO members: (i) pure innovators or upstream-only firms (i.e., firms which develop technologies and earn their revenues by licensing them); (ii) pure manufacturers or downstream-only firms (i.e., firms which manufacture products based on technologies developed by others); (iii) vertically-integrated firms (i.e., firms which both develop and license technologies, and manufacture products based on their technologies and the technologies of others); and (iv) firms which do not create technologies or manufacture products, but buy products which are manufactured on the basis of patented technologies.

While there is a certain degree of fluidity between these categories, they are helpful to show that members of SSOs have very different incentive structures. *Pure innovators* are entirely, or at least largely, dependent on licensing revenues to continue their operations. These revenues should be sufficiently substantial to cover the costs incurred in developing the technologies they produce (including the costs of failed projects), as well as to give them sufficient incentives to engage in complex and risky projects in the future. *Pure manufacturers* have converse incentives as for them licensing fees represent a cost they have every incentive to reduce. The lower the level of royalties they pay, the higher their potential level of profits. *Vertically-integrated firms* have mixed incentives. One the one hand, they can draw revenues from their patented technologies, while on the other hand, they will have to pay royalties to firms holding essential patents in the standard for the products they manufacture. Since the bulk of the revenues (and profits) of these firms are generally made downstream, these firms are much less dependent than pure innovators on royalty revenues. These firms, in their licensing negotiations with other firms, may well be more interested in cross-licensing their rights to protect their downstream business than in charging royalties. *Buyers of products* implementing standards relying on patented technologies are generally in line with manufac-

turers. They generally consider that the royalties, which manufacturers pay to IP holders, increase the price of the products they buy from such manufacturers.[13]

This explains why debates are particularly tense within SSOs and why it is difficult for its members to reach consensus on IPR-related issues. As will be discussed below, this also explains why some industry segments have made a variety of proposals designed to reduce the bargaining power of essential patent holders in order to reduce license fees (see Part 6.4 below).

6.3 The Patent Hold-Up Conjecture

It is often alleged in the mainstream literature that standard implementers face significant risks of patent hold-up and royalty-stacking. It has, for instance, been suggested that the "owner of a relevant essential patent has the ability to … demand royalties for that patent that are significantly higher than the royalties it could have demanded had the technology not been included in the standard, or before the standard was adopted and competition eliminated (known as the 'hold-up' problem)."[14] For others "the market test fails when a patent holder can demand royalties after users have sunk specific investments in the course of beginning (or preparing) to use the patented technology."[15]

Although the alleged ability of essential patent owners to hold-up standard implementers by charging them excessive royalties or

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[13] Note that this is, however, only true if the manufacturing market is competitive. If this market is not competitive, royalty savings are unlikely to be passed on to buyers.

[14] See Chappatte, supra note 2, at 326.

[15] See Farrell et al. supra note 2, at 612.

imposing on them other unfair licensing terms has become a common fixture of the standard-setting literature, there is simply no empirical evidence that any industry standard has been significantly harmed by "hold-up". In the *Qualcomm* case, for instance, the complainants, six large vertically-integrated firms, argued that Qualcomm fees were "excessive and disproportionate" and that they would "hold back adoption of 3G."[16] This prediction proved entirely wrong as since 2005 the market for 3G phones has grown tremendously making 3G one of the most successful standards ever adopted.

This paper is not suggesting that patent hold-up is not theoretically possible, and that it has never occurred, but that the occurrence of this problem is rare and that therefore the drastic remedies that the proponents of the hold-up conjecture propose are not justified (see Section 6.4 below). This conjecture is indeed based on premises which, in practice, will rarely occur in the real world.

First, this conjecture is based on the premise that sufficiently close alternative technologies existed at the time of adoption of a particular standard, and that standardisation eliminated technology competition. This may not necessarily be the case. There will be circumstances when there is no hold up as only one technological solution allows to perform a certain function. In this case, the royalties charged by the essential patent holder will not be higher than those it would have charged before the adoption of the standard in question as any market power this patent holder may hold pre-existed that standard and is due to the uniqueness or superiority of its technology. Standardization will increase the revenues of the essential patent holder when its licensing fees take the form of a per unit fee or a percentage of sales price, but this is due to the fact

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[16] See Andy Reinhardt, "A Scrum over Qualcomm's Fees", *Business Week*, 31 October 2005.

standardization grows volumes, not opportunistic behaviour on the part of the essential patent holder.

Second, the hold-up conjecture assumes that licensing terms were unknown and unavailable prior to standardisation, which is often not the case. In fact, the majority of key patent owners and standard implementers commonly engage in *ex ante* licensing negotiations – that is, they routinely negotiate patent portfolio licenses or cross-licenses pertaining to an anticipated standard, or to a standard under development, well before the standard is finalised. IPR holders have a clear interest in engaging in such ex ante negotiations in order to build support among SSO members for their technology. Hence, if manufacturers are genuinely fearful that they are at risk of *ex post* "hold-up" by essential patent owners, they are at liberty to pursue pre-standardisation licenses systematically, and to be mindful during the standardisation process of any IPR holders who would have refused to enter in negotiations for such licenses.

Third, the hold-up conjecture posits that standards implementers must have made significant technology-specific investments – and are thus "locked-in" – before an owner of essential patents is able to extract more favourable licensing terms than the value of its patent portfolio would warrant. In practice, there is indeed often a time lag between the formal adoption of a standard by an SSO and the beginning of significant investments by standard implementers. This time lag affords SSO members and potential implementers sufficient time *ex post*, in addition to that *ex ante*, to consider the licensing terms sought by the major essential patent IP owners.

Finally, the hold-up conjecture is also based on the premise that firms whose market power may have increased as a result of standardisation will necessarily be able to exploit it. This entirely ignores the fact that firms which hold patents relevant for a standard also face a number of important constraints, such as their needs to license essential patents from some of their licensees (hence, giving these licensees a means to retaliate should the licensing terms be unreasonable) when they are themselves engaged in manufacturing standard-compliant products, their interest in making the standard

affordable in order to drive volumes and stimulate their revenues, and the fact that standardization is a repeated game, hence allowing SSO members to punish firms seeking to hold up a standard.[17]

It can therefore be expected that the only firms which may not be significantly constrained and may attempt to charge royalties that are not fair and reasonable will be those that (i) have gained market power through standardisation (because their technology competed with other viable alternative technologies *ex ante* standardisation); (ii) are not engaged in the manufacture of any final or intermediate products compliant with the standard and are thus not constrained by their need to obtain cross-licenses; and (iii) are not actively engaged in standardisation processes and have no expectation whatsoever to participate in such processes in the future. These circumstances are sufficiently rare to make clear that, although theoretically possible, hold-up is very unlikely to occur in practice.

6.4 Significant Risks Faced by Innovators Active in Standardized Fields

This Part seeks to show that while the patent hold up literature largely exaggerates the risks of patent hold-up by essential patent holders, it also largely underestimates or even ignores the risks faced by innovators active in standardized fields. Innovation is a risky business and, in standardized fields, it is even riskier considering that even successful technologies, in that they offer a technically viable solution to an important problem, will not necessarily be selected to form part of the relevant standard (Section A). In addition, we will see that that even holders of patents essential to a standard (i.e., companies whose technology has been selected to be part of a

[17] See Geradin and Rato (FRAND Commitment and EC Competition Law), supra note 2, at 146.

standard) may increasingly find it hard to monetize their innovation given the various efforts made by standard implementers to constrain their bargaining power. (Section B) Finally, we will see that some standard implementers have used EU competition rules to challenge the licensing terms agreed with essential patent holders on the ground that they breached the FRAND commitment made by these patent holders and thus, they alleged, violated Article 102 TFEU. (Section C). In light of these developments, innovators may be at risk of "reverse hold-ups" whereby their reward would be inferior than the contribution of their technology to the standard. Instead of being over-rewarded, as hold-up theorists claim, essential patent holders would be under-rewarded.

A. Innovation is a risky business

Innovators do not have an easy life. They often face obstacles to obtain the capital needed to carry out their R&D efforts, as well as to bring these efforts to fruition once that capital has been found. These obstacles are compounded where innovation is carried out in standardized fields.

1. Challenges faced by innovators

Innovation requires that significant investment be made today to generate uncertain returns tomorrow. Obtaining the necessary capital to pursue R&D requires an innovator to convince investors that a number of conditions are met, including that: (i) its R&D will achieve results sooner than those of others engaging in similar, or at least comparable, R&D, and those results will be demonstrably superior to those of others for a substantial period of time; (ii) there will be an adequate supply of necessary, complementary products, services, and technologies (e.g., wireless handsets, infrastructure equipment, attractive content, etc.); (iii) there will be one or more "platforms" or real commercial "laboratories" to test the technical, commercial and financial feasibility of the invention; (iv) it will be able to defeat op-

position to change, customer inertia, and the resistance of powerful incumbents whose businesses may be "disrupted" by its invention; and, if it adopts a licensing business model, (v) it will be able to obtain the patents necessary to protect its inventions and, if necessary, that it will have the resources to enforce them in multiple fora in cases involving multiple parties.

But even if an innovator manages to obtain the necessary capital to pursue a given R&D project, this gives it no guarantee that its investments will bear fruition. Its research may not lead to any concrete results or may lead to results that may not be subject to commercial exploitation. While there is obviously no precise data with respect to the success (or failure) rate of R&D projects, the conventional wisdom is that the vast majority of such projects fail. An additional problem is that, although frequent, failure is very hard to predict and prevent as its causes can be numerous (e.g., insufficient resources, unrealistic completion timeframe, loss of key personnel, failure to obtain authorizations from regulators, etc.) and complex (e.g., technological shifts, unpredictable changes in the commercial landscape, etc.). Although innovator can learn from experience, there is nothing like a failure-proof research project.

The above considerations are important as they illustrate why investors will only accept to fund R&D projects provided that, if successful, they generate significant returns.[18] It is a basic law of

[18] For instance, the price of a drug prescribed to patients will obviously be well above its marginal cost of production as this price generally needs to cover years of research over thousands of compounds, trials on animals and then human beings, and extremely stringent controls by health authorities. Thus, significant margins are justified by the need to compensate for the huge costs generally associated with the development of the drug in question, including the costs of failed projects, as well as those associated with the many complex procedures necessary to allow commercialization. Forcing firms to reduce their margins may thus constrain innovation.

finance that the return expected by investors are directly proportionate to the risks involved in the proposed investment. Given that profits are uncertain when an R&D project is funded, an investor will only be willing to invest if the expected return on its investment exceeds the cost of capital by a significant measure.[19] The need to motivate investors to dedicate their resources to risky R&D projects is also the rationale of the patent system. As correctly observed by the Commission its Guidelines on Technology Transfer Agreements:

"In order not to reduce dynamic competition and to maintain the incentive to innovate, the innovator must not be unduly restricted in the exploitation of intellectual property rights that turn out to be valuable. For these reasons the innovator should normally be free to seek compensation for successful projects that is sufficient to maintain incentives, taking failing projects into account."[20]

Thus, attempts by implementers to affect the ability of innovators to generate the type of returns that will motivate R&D investments in the first place (see Sections B & C below), by for instance trying to weaken their bargaining power or to cap the royalties they can draw from licensing their technologies, will inevitably harm innovation. In addition, even changes that merely increase uncertainty as to what return an innovator will be able to recover can be expected to have a depressing effect on investment and innovation as they will make capital available for R&D scarcer and more costly.

2. The additional challenges faced by innovators active in standardized fields

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[19] See, e.g., Richard Brealey, Stewart Myers and Franklin Allen, *Principles of Corporate Finance*, 238-39 (2008).

[20] Commission Notice — Guidelines on the application of Article 81 of the EC Treaty to technology transfer agreements, OJ 2004, C 101/2, para. 8.

While innovators generally face significant risks given the painful nature of the "trial and error" process characterizing innovation, they face additional challenges when their research takes place in a field that is subject to industry standardization. The reason is that innovators have no guarantee that, however valuable, their technology will be selected to be part of the relevant standard. The key function of standardization is to select the technologies that will be part of the standard and, in the presence of several alternatives, competition for inclusion in the standard will generally be fierce. This competition may also not be fair as its outcome will often depend on the respective influence or strength of the various technology developers in the SSO in question, hence creating a risk that second best technology be selected.

Thus, in a standardized industry even if an R&D project is "successful" in the sense of developing a technically viable solution to an important problem, it may happen that a different solution is eventually included in the standard. While in some instances inter-standard competition or competition by a proprietary technology may be viable, in other cases the "loser" of the standardization process may be effectively shut out, obtaining zero return on investment. This adds to the "uncertainty" that characterizes innovation and the ability of innovators to earn a return on investment.

B. Efforts to lower royalty rates by weakening the bargaining power of essential patent holders

At the core of the hold-up conjecture is the fact that holders of patents essential to practice a standard enjoy significant market power conferred by standardization.[21] As we have seen, the claim is

[21] See, e.g., Marcus Glader and Sune Chabert Larsen, "Article 82: Excessive pricing – An outline of the legal principles relating to excessive pricing and

that once a given technology is selected to become an essential part of a standard, competition between technologies for that part of the standard ends. No longer constrained by such competition, each owner of IPR essential to the standard would *ipso facto* enjoy significant market power in the market(s) for the licensing of those IPR, which it would have incentives to abuse.

While this over-simplistic view ignores that (i) market power may exist prior to standardization and (ii) even when (extra) market power is granted by standardization essential patent holders will typically be subject to a series of constraints that will limit their ability to seek unreasonably high royalties or other exploitative licensing terms,[22] it has nevertheless led to a variety of proposals explicitly or implicitly designed to weaken the bargaining position of such patent holders, which are described hereafter.

1. Proposals for Collective Negotiations of Royalties

It has been suggested that an appropriate manner to eliminate the risk of hold-up by essential patent holders is to allow standard implementers to engage in joint negotiations of royalties between and among potential licensors and licensees before a standard is formally adopted.[23] The idea behind this proposal is that joint negotiations create the collective *buyer* power that is necessary to counterbalance the *seller* power enjoyed by essential patent holders. But this approach should be flatly rejected.

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their future application in the field of IP rights and industry standards", *Competition Law Insight*, 4 July 2005, at 3.

[22] See Geradin & Rato (FRAND Commitment and EC Competition Law), supra note 2.

[23] See, e.g., Ohana et al., supra note 5; See Skitol, supra note 5.

First, there is no doubt that these negotiations would be primarily aimed at depressing the royalties which standard implementers would normally pay to essential patent holders for no other reason than to lower their IP acquisition costs. Proponents of joint negotiations do not indeed require that the conditions for hold up be present for such negotiations to take place. They thus create a significant risk of "reverse hold-up" scenario whereby essential patent holders could be forced to settle for royalties that are lower that the value of their innovation.[24] This point has been made by Rich Gilbert in a recent paper:

> "Join negotiation raises concerns that members of a SDO may engage in a different type of hold-up by suppressing royalty terms after rights holders have made irreversible research and development investments necessary to create and patent technologies that are essential to a standard, a concern that is particularly acute for "pure-play" R&D companies that derive all or most of their revenues from licensing. With R&D expenditures already sunk, patentees may have little choice but to accept low royalty terms."[25]

Second, joint negotiations would unduly rigidify the licensing process and lead to sub-optimal licensing agreements. From that standpoint, bilateral negotiations are clearly superior in that they

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[24] See David Teece & Edward Sherry, "Standards Setting and Antitrust", (2003) 87 *Minnesota Law Review*, 1913, at 1955 ("One key issue concerning patents is whether the patent holder must announce the terms for a patent license in advance. If so, there are potential antitrust concerns. Typically, the other participants in the SSO are the most likely potential licensees for the patent. This raises the potential for collusive, oligopolistic 'price fixing' in the technology market."). For a different view, see Skitol, supra note 5, at 739.

[25] See Richard Gilbert, "Deal or no Deal? Licensing Negotiations by Standard Development Oraganizations", August 2010, available at http://escholarship.org/uc/item/1642q403

allow tailored-made deals. Potential licensees with significant patent portfolio may, for instance, conclude agreements providing for low (or even the absence of) royalty rates in return for a cross-license. Potential licensees may also have different preferences in terms of the methods of payment, for instance preferring an upfront fee to running royalties, etc.

Finally, joint *ex ante* negotiations of royalties would trigger serious antitrust concerns as they require that competing firms collaborate during royalty negotiations, hence effectively acting as a buyer cartel.[26] Such collaboration certainly falls foul of Article 101(1) TFEU on several grounds. First, joint *ex ante* negotiations give rise to the risk that potential licensees threaten to exclude a potential licensor's technology unless that potential licensor offers a royalty they considered "appropriate" (although it may be unreasonably low and insufficient to cover the potential licensor's investment). As pointed by Bob Skitol, a leading proponent of joint negotiations, "a patent owner's refusal to accept terms satisfactory to the group as a whole would cause the group to consider alternatives to the use of that owner's technology."[27] Such a threat amounts to no less than a

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[26] See Daniel Swanson and William Baumol, "Reasonable and Nondiscriminatory (RAND) Royalties, Standards Selection, and Control of Market Power", 73 (2005) *Antitrust Law Journal* 1, at 12-13 ("The standardization process typically involves consultation and agreements among firms that are often competing buyers of IP and also may be competing sellers in the downstream product markets. While joint decision making by competitors can sometimes promote the general welfare, it always entails the danger of misbehavior for anticompetitive purposes, such as the threat of behavior aimed at collusively reducing the price paid for intellectual property.")

[27] See Skitol, supra note 5, at 729.

collective boycott[28] or an anti-competitive exercise of oligopsony power.[29] In addition, the uniform licensing terms resulting from joint *ex ante* royalty negotiations would lead to a homogenization of the conditions of competition (giving the setting of a common purchase price for an essential input, i.e. the essential patents) and could facilitate collusion in the downstream product market.

A number of authors and antitrust enforcers have drawn attention to these antitrust risks and warned that any such joint *ex ante negotiations* would attract thorough scrutiny.[30] While some, correctly in the author's view, have argued that joint negotiations of licensing terms should be *per se* illegal,[31] others have claimed that such negotiations should be reviewed under the *rule of reason*.[32] Former Federal Trade Commission (FTC) Chairman Debbie Majoras, for instance, noted in that capacity that "joint ex ante royalty discussions that are reasonably necessary to avoid hold up do not warrant per se condemnation. Rather, they merit the balancing undertaken in a rule of reason review".[33] Similarly, the draft Com-

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[28] Id. ("The SSO members would, in effect, say to the patent holder, 'We will collectively reject a standard that incorporates your patented technology unless you agree to license it to us at pre-specified rates that we collectively find acceptable.' In other contexts, this clearly would amount to a group boycott.")

[29] See Sidak, supra note 5.

[30] See Skitol, supra at note 5.

[31] See Sidak, supra note 5.

[32] For an excellent analysis of the way such a rule of reason analysis should be conducted, see Gilbert, supra note 25.

[33] See also "Recognizing the procompetitive potential of royalty discussions in standard setting", Remarks of FTC Chairman Deborah Platt Majoras delivered at Stanford University, 23 September 2005, available at http://www.ftc.gov/speeches/majoras/050923stanford.pdf at 7.

mission Guidelines on Horizontal Agreements state that while SSO imposed requirements for ex ante disclosure of most restrictive licensing terms "will not … lead to a restriction of competition within Article 101(1)", but only "as long as the rules do not allow for the joint negotiation or discussion of licensing terms in particular royalty rates."[34] Although there appears to be no valid justification to derogate from the *per se* rule that normally applies to horizontal coordination over prices, such a rule of reason-type analysis would require weighing the anticompetitive effects of joint negotiations against the pro-competitive benefits expected.

The question thus arises whether a proposed joint negotiations regime could benefit from the application of Article 101(3) TFEU, which, for the reasons discussed hereafter, is quite doubtful.[35] First, joint negotiations would have an adverse impact on the rewards granted to licensors as they have no other purpose than reducing the royalty burden faced by standard implementers and pure innovators, which fund their R&D through licensing revenues, would be particularly affected. Rather than promoting "technical innovation or

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[34] Draft Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements, SEC(2010) 528/2.

[35] See Swanson & Baumol, supra note 26, at 13-14 ("In the case of the typical SSO … the integration and efficiencies needed to justify outright collective bargaining on royalties are in short supply."); See Carl Shapiro, "Setting Compatibility Standards: Cooperation or Collusion?", in Rochelle Dreyfuss, Diane Zimmerman & Harry First, Eds., *Expanding the Bounds of Intellectual Property*, Oxford University Press, 2001 at Section I. ("While the law has typically looked for integration and risk-sharing among collaborators in order to classify cooperation as a joint venture and escape per se condemnation, ... the essence of cooperative standard setting is not the sharing of risks associated with specific investments, or the integration of operations.")

economic progress" joint negotiations would likely have a negative impact on the completion of such objectives.

Second, it is far from certain that end-consumers (e.g., buyers of standard-compliant products) would be allowed "a fair share of the resulting benefit" of joint negotiations, which from would essentially amount to an exercise in rent-shifting between innovators and implementers. There is no empirical foundation for the proposition that the payment of lower royalties to innovators would automatically lead to lower selling prices of the products implementing the standard. Prices at the end-user level depend on a complex number of factors, not least the level of competition between standard implementers at the downstream product level. Just as higher royalties could be internalised by such manufacturers, lower royal-ties would not necessarily be passed along to consumers.

Third, a system of joint negotiations of royalty rates does not appear necessary (i.e. the least restrictive means available) to achieve the objective allegedly sought by the proponents of this *ex ante* regime (i.e., preventing perceived risks of *ex post* opportunism and increasing certainty as to the implementation costs of a given standard). A system whereby the SSO requires essential patent holders to individually disclose their most restrictive licensing terms, including the maximum royalty they would charge, should their technology be included in the standard in question prior to its adoption is, although not exempt of problems,[36] a less restrictive means to achieve the objectives sought by the proponents of joint negotiations. Similarly, Rich Gilbert convincingly argued that a system of bilateral negotiations between potential licensors and licensees combined with a clear

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[36] See Damien Geradin and Anne Layne-Farrar, "The logic and limits of ex ante competition in a standard-setting environment", 3 (2007) *Competition Policy International* 79.

non-discrimination requirement would represent an attractive alternative to joint negotiations.[37]

Finally, joint *ex ante* negotiations would eliminate the competetion taking place between standard implementers under the current regime of voluntary disclosure of essential IPR whereby each standard implementer has to negotiate a license with each essential patents holder. Negotiation is an essential part of the competitive process and there is no valid reason why it should be eliminated.

In sum, there are no credible pro-competitive reasons justifications for joint negotiations of royalty rates and other licensing terms, which should therefore neither survive a rule of reason or an Article 101(3) analysis. Joint negotiations would hurt innovators by lowering their royalty revenues and, thus, their ability to invest in R&D. If anything, such negotiations would thus translate in a loss of dynamic efficiencies without sufficient countervailing benefits.

2. Depriving the ability of essential patent holders to seek injunctive relief

Patent injunctions play a central role in Lemley and Shapiro's hold up conjecture:

> "The threat that a patent holder will obtain an injunction that will force the downstream producer to pull its product from the market can be very powerful. ... Injunction threats often involve a strong element of hold-up in the common circumstance in which the defendant has already invested heavily to design, manufacture, market, and sell the product with the allegedly infringing feature. The threat of an injunction can enable a patent holder to negotiate royalties far in excess of the patent holder's true economic contribution."[38]

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[37] See Gilbert, supra note 25.

[38] Lemley & Shapiro, supra note 1.

Lemley and Shapiro thus plead for a narrowing of the circumstances in which injunctive relief should be granted to the patentee. Specifically, they argue that injunctive relief should be: (i) stayed (until the infringer has an opportunity to design around the patented feature) when the value of the patented feature is only a small part of the value of the final product and (ii) denied when the patent holder is a non-practicing entity (i.e., a firm that does not practice its patents by, for instance, manufacturing products).[39]

Lemley and Shapiro's proposals are, however, based on the questionable premise that a patent holder's ability to seek injunctive relief against downstream producers allows it to negotiate excessively high royalties. But that is not necessarily true. As pointed out by John Golden, one should not lose sight of the fact that the patent holder negotiates with knowledge that it will be burdened with significant costs if negotiations fail and that such costs "could drive the patent holder to settle for substantially less that the patented invention's more intrinsic economic worth."[40] For instance, the patent holder will face significant litigation costs if negotiations fail and its patents have to be enforced through the courts, which if it is a small company is not even an option. In addition, when a patent holder wants to license non-exclusively, its failure to successfully conclude negotiations with a "first mover" licensee will significantly undermine its ability to negotiate licenses with other potential licensees.[41] Thus, although the patent holder may be able to threaten a potential licensee that it would seek a court injunction if negotiations broke

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[39] For a rebuttal of Lemley and Shapiro's proposals, see Vincenzo DeNicolo et al., "Revisiting Injunctive Relief: Interpreting *eBay* in High-Tech Industries with Non-Practicing Patent Holders", (2008) 4 *Journal of Competition Law and Economics* 571.

[40] Golden, supra note 1, at 2133.

[41] Id. at 2134.

down "years of time and a million dollars or so dollars likely stand down between such a threat and its realization."[42]

But the situation would be much worse if the threat of injunction disappeared from the patent holder's legal arsenal and its only available relief were an *ex post* award of damages. In that scenario, any firm wishing to implement a standard would be invited to begin immediately using the invention without even trying to obtain a license from the IP owner and take its chances in court later.[43] This would be a patent infringers' charter and would provide an incentive for standard implementers to refuse beforehand to enter into license agreements on FRAND terms, limiting patent owners to enforcing their rights through what could be patent-by-patent, country-by-country damages claims. In those circumstances, patent owners, especially if they are small firms, would arguably prefer to settle for a license on terms that would not provide a fair return on their investment, in other words terms which would not be in line with FRAND, rather than face lengthy, onerous and uncertain court proceedings for the award of damages.[44] This would amount to nothing less than a reverse patent hold-up, this time committed by the standard implementer, which would be in a position to refuse a license on FRAND terms proposed by the patent owner but still

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[42] Id. at 2134.

[43] For those infringing implementers, the worst case scenario would merely be a requirement to pay damages once a court had established the infringement.

[44] In his reply to Lemley and Shapiro, Greg Sidak concludes that those authors' recommendations for patent reform, including in particular the denial of injunctive relief, are not supported by conjecture, would results in bias in favour of the infringing party and would create more problems than they would solve. See, J. Gregory Sidak, "Holdup, Royalty Stacking, and the Presumption of Injunctive Relief for Patent Infringement: A Reply to Lemley and Shapiro", (92) 2008 *Minnesota Law Review* 714.

remain immune from injunctions for infringement. Faced with the prospect of spending millions of dollars and several years in the courts, patent holders would be forced to settle for royalties that would be lower that the true value of their inventions, a result that would be fundamentally un-FRAND.

In addition, while designed to address the problems created by "patent trolls",[45] the distinction Lemley and Shapiro's proposal to distinguish between "practicing" and "non-practicing" entities, depriving the latter of the right to seek an injunction, makes little sense. It would unduly affect innovators which have opted for a licensing business model for perfectly legitimate reasons, such as for instance the fact that they do not have the skills or the resources to develop and manufacture products embedding their technologies. The paradoxical effect of that proposal would be that the firms that are the most likely to license their patents (because licensing is their business model and they need licensing revenues) would be granted the least leverage in licensing negotiations by truncating their rights granted to them by law. In fact, by assimilating true innovators with "patent trolls", whose business is perhaps best described as an effort to acquire patents from other firms with the sole purpose to sue potential infringers,[46] under the vague notion of non-practicing entities, Lemley and Shapiro's proposal would effectively tip the market in favour of vertically-integrated incumbents. This would impede

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[45] On the problems created by patent trolls, see Gerard N. Magliocca, "Blackberries and Barnyards: Patent Trolls and the Perils of Innovation", 82 (2007) *Notre Dame Law Review* 1809. For a different take on patent trolls, see James F. McDonough III, "The Myth of the Patent Troll: An Alternative View of the Function of Patent Dealers in an Idea Economy", (56) 2006 *Emory Law Journal* 189.

[46] Authors have recognized the difficulty of defining the notion of "patent troll". See, e.g., Ronald J. Mann, "Do Patents Facilitate Financing in the Software Industry?", 83 (2005) *Texas Law Review* 961, 1023.

efficiency-enhancing specialization allowing firms to focus on what they do best and harm innovation.[47]

In any event, following the Supreme Court's 2006 decision in *eBay v. MerExchange L.L.C.*, in which it rejected a "general rule that courts will issue permanent injunctions against patent infringement absent exceptional circumstances",[48] it is subject to question whether the waiver conjecture remains of much policy relevance at least as far as the United States are concerned. Justice Thomas, writing for the majority, called for the lower courts to adhere to the four-part equity test already established in the case-law. Under that balancing test, before a plaintiff may receive injunctive relief it is required to demonstrate that: (i) it has suffered an irreparable injury; (ii) remedies available at law are inadequate to compensate for that injury; (iii) considering the balance of hardships between the plaintiff and a defendant, a remedy in equity is warranted; and (iv) the public interest would not be disserved by an injunction. Lower courts thus have the flexibility to stay or deny an injunction when appropriate.

Despite all this, some authors have sought to extend and expand Lemley and Shapiro's proposals to standardized fields in arguing that by making a FRAND commitment an essential patent owner waives its right to seek injunctive relief in case of infringement.[49] Al-

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[47] See Richard Schmalensee, "Standards-Setting, Innovation Specialists and Competition Policy", LVII (2009) *The Journal of Industrial Economics* 526, 528; Damien Geradin et al, "Elves or Trolls? The Role of Non-Practicing Patent Owners in the Innovation Economy", *Industrial and Corporate Change* (forthcoming), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1136086

[48] *eBay*, 126 S. Ct. at 1839, 1839–41 (quoting MercExchange, L.L.C. v. eBay, Inc., 401 F.3d 1323, 1339 (Fed. Cir. 2005), *vacated*, 126 S. Ct. 1837 (2006)).

[49] For instance, in a paper published in 2002, Maurits Dolmans claims that "[o]wners of essential IPR for *de facto* or *de jure* standards (and especially those who have committed to FRAND licensing in order to obtain an

though the proponents of the "waiver theory" argue that essential patent holders have or should have no right to seek injunctive relief and instead can only seek damages for IP infringement, their position is grounded neither on statute nor case-law, as there is no such precedent for them to invoke.[50] There is indeed no provision or indication whatsoever in the main SSOs' IPR Policy supporting the proposition that a patent owner who has given a FRAND commitment is prevented from applying for an injunction against patent infringers, for instance where the patent owner has offered but the infringer has rejected license terms consistent with FRAND.

In addition, the making of a FRAND commitment by an essential patent holder cannot be interpreted as an implicit waiver to its right

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exemption under Article 81(3) EC) should limit themselves to suits for damages and refrain from requesting injunctive relief against implementers." See Maurits Dolmans, "Standards for Standards", (2002) 26 *Fordham Int'l L J* 163. See also Joseph Miller, Standard Setting, Patents, and Access Lock-In: RAND Licensing and the Theory of the Firm, 40 Indiana L. Rev. 351 (2007), at 351 ("[e]very participating patent owner has, by making the RAND licensing promise, irrevocably waived its right to seek the most traditional of intellectual property law remedies, a court injunction against unauthorized access. The only relief a frustrated patent owner can seek against an adopter thereafter is the reasonable royalty expressly contemplated."

[50] The right of IP owners to seek injunctive relief is recognized under international trade law (Article 41(1) of the Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS agreement), Annex 1C to the Marrakech Agreement Establishing the World Trade Organization, signed in Marrakech, Morocco on 15 April 1994) and EU law See Directive 2004/48 of the European Parliament and of the Council of 29 April 2004 on the enforcement of intellectual property rights [2004] OJ L157. It is also expressly guaranteed under U.S. federal law. See U.S. Patent Act, Part III., Chap.29, Section 283.

to seek injunctive relief as recognised in the law. Such an interpretation would be in sharp contradiction to an established principle of law according to which the waiver of a right can never be assumed lightly and must always be made explicitly or must at least be derived from circumstances that cannot possibly be interpreted any differently than the right owner's consent to waive its right.[51] Much to the contrary, the "waiver theory" merely reflects IP policy preferences that may or may not be deemed in future to have merit, but for which no historical consideration was given when most (F)RAND policies were adopted[52] and which should certainly not be retroactively applied to FRAND commitments given in the past.

3. Proposals to reinterpret the meaning of FRAND as a tool to constrain essential the ability of patent holders to monetize their innovation

As we have seen above, before the adoption of a standard, SSOs typically request essential patent holders to give a FRAND commitment. The rationale behind the FRAND commitment – and the "fair and reasonable" terms that are part of it – is twofold: (i) to ensure dissemination of the essential IPR contained in a standard, thereby

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[51] This very basic principle is recognised in all European continental (See, e.g., Belgian Supreme Court, 19 September 1997, *Arr Cass* 1997, 840 and French Supreme Court, 10 May 2000, Case No 97-13907) and common law legal systems See, e.g., Schoon v Troy Corp, CA No 1677-N, 2006 Del Ch LEXIS 123, *7 (Del Ch June 27, 2006).

[52] Lemley explicitly admits that he is "aware of no cases treating this issue", stating that it is his "policy preference" that an IPR owner's commitment to an SSO be construed as itself implying the grant of a license, with the result that the IP owner is precluded form seeking an injunction for patent infringement. See Mark Lemley, "Intellectual Property Rights and Standard-Setting Organizations", (2002) 90 *California Law Review* 1889, 1926.

allowing it to remain *available* for adoption by members of the industry, whilst at the same time (ii) making certain that holders of those IPR are able to *reap adequate rewards* from their innovations.[53]

Some authors have, however, sought to reinterpret the notion of FRAND to claim that it amounts to a promise by essential patent owners "that they will moderate their royalty claims".[54] This claim is, however, contradicted by the plain language of the IPR policies of the main SSOs. No IPR policy can be read as suggesting that FRAND imposes any specific and concrete obligations on the owner of standard essential patents with regard to the actual level of royalties or any other terms and conditions provided for in licensing agreements.[55] Nevertheless, a number of methods have been pro-posed to determine the extent to which the royalty sought by an essential IPR holder is compliant with the FRAND commitment this IPR holder made to the relevant SSO.

The first benchmark proposed to determine whether a given royalty rate is FRAND is commonly referred to as "numerical proportionality". Pursuant to that method an essential IPR holder's entitlement to royalties should be calculated in the light of the proportional contribution of that patent owner's essential patents compared to the total contribution of all other essential patents reading on the standard.[56] For example, if one patent owner declared

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[53]The latter goal lies at the heart of the patent system, and is as essential to the success of the standards enterprise as the former.

[54] See Chappatte, supra note 2, at 327.

[55] See Roger Brooks & Damien Geradin, "Taking contracts Seriously: The Meaning of the Voluntary Commitment to Licence Essential Patents on "Fair and Reasonable" Terms, in S. Anderman and A. Ezrachi, *Intellectual Property and Competition Law: New Frontiers*, forthcoming 2010.

[56] That approach can be illustrated by the proposal made by some ETSI members (Nokia, Ericsson, and Motorola) that ETSI's current IPR policy be

10 essential patents out of a total of 100, and another patent owner declared 20 essential patents out of a total of 100, the value of the second patent owner's essential patent portfolio would be twice as high as the first patent owner's essential patent portfolio (20% versus 10%).

Numerical proportionality – which amounts, in essence, to a simplistic formula that counts patents – is seriously flawed and simply unfit to value essential patents. First, numerical proportionality unavoidably requires the determination of a "cumulative royalty cap", which would represent the baseline pursuant to which royalties would be allocated to essential patent holders based on their numerical contribution to the standard. Industry would thus, for instance, decide that the cumulative royalties applied to a given product should not exceed 10% of the value of that product as a result of which the royalties of an innovator holding 10% of the essentials patents could not be higher than 1% (10% of 10%). The proponents of that method, however, cannot explain the basis and legitimacy for the determination of such a cumulative royalty cap, which would necessarily limit, pursuant to some unclear basis, the rewards available to innovators.

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revised in order to introduce the principles of "aggregated reasonable terms" and "proportionality" into the definition of FRAND. Pursuant to this proposal, called "Minimum Change, Optimal Impact", Aggregated Reasonable Terms would mean that "in the aggregate the terms are objectively commercially reasonable taking into account the generally prevailing business conditions relevant for the standard and applicable product, patents owned by others for the specific technology, and the estimated value of the specific technology in relation to the necessary technologies of the product." In turn, proportionality would mean that "compensation under FRAND must reflect the patent owner's proportion of all essential patents." See "Vendors Seek Compromise on LTE", Informa Telecoms and Media, 20 March 2006.

Second, numerical proportionality rests on the proposition that every essential patent in a standard is of equal value – a proposition that the Competition Committee of the OECD Directorate for Financial and Enterprise Affairs has flatly stated to be "meritless."[57] Specifically, numerical proportionality ignores the fact that the economic value of a particular patent or patent portfolio depends on the benefits it provides to the industry and ultimately consumers, which is far from a function solely of the number of patents.[58] Clearly, (essential) patents are not equal and that simple fact makes numerical proportionality meaningless.

Third, numerical proportionality would inevitably stifle innovation as it would incentivize firms to seek to generate as many essential – or at least claimed to be essential – patents as they could, hence favouring corporations with extensive IP departments able to file large numbers of marginally varying patents. If a smaller, innovative entity develops the next new breakthrough or "core" patent with a value far surpassing all prior patented technologies, the numerical proportionality formula would prevent it from being rewarded for its investment. If anything, a benchmark that awards the highest royalties within a given standard to the firm with the greatest share of patents would also encourage "game playing" by fostering the introduction of large numbers of unnecessary technologies

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[57] See OECD, Directorate For Financial and Enterprise Affairs, Competition Committee, "Background Note by the Secretariat – Roundtable on Competition, Patents and Innovation", 25 May 2009, p. 15.

[58] Standards will generally involve multiple essential patents. Certain of these patents go to the core of elements of the technology being addressed. Many other essential patents are dependent on or complementary to these core patents. The former are of far greater importance, and more valuable, to the technology under development than the latter.

into standards in order to maximize each company's "patent count."[59]

Finally, numerical proportionality would face the insurmountable problem that it would require a subjective assessment of the total number of essential patents included in a given standard and the percentage of such patents allocated to the various contributors. These numbers are, however, constantly changing as the standard evolves (with new releases being issued or declared patents being successfully challenged) rendering such an assessment practically impossible.[60]

A second benchmark proposed to determine whether a given rate is fair and reasonable is based on a comparison between the rate offered *ex post* standardization by the essential patent holder in question with the rate this patent holder offered for the same patents *ex ante* standardization. While this approach makes much greater sense than numerical proportionality, carrying such an ex ante/ex post comparison would typically be an extremely difficult undertaking as technology licenses are complex instruments comprising different forms of consideration (upfront licensing fees, royalties,

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[59] See Damien Geradin, Standardization and Technological Innovation: Some Reflections on Ex-ante Licensing, FRAND, and the Proper Means to Reward Innovators, 29 (2006) *World Competition* 511.

[60] The existing SSOs' databases listing declarations by patent owners do not provide a suitable basis for such (inappropriate) patent counting. Indeed, not only are such lists (often comprising thousands of patents) merely indicative (they do not contain the whole universe of essential patents), but the patents contained therein have been merely declared as possibly essential to the standards by their owners. Those patents may or may not prove ultimately to be essential to the standard. A proper determination of essentiality of hundreds if not thousands of declared patents would prove a massive, hugely costly and highly uncertain task and is, for that reason, usually not conducted by SSOs.

cross-licenses, etc.). The practical implementation of this test is thus prone to errors as competition authorities face the risks of comparing apples with oranges (e.g., an agreement with a high royalty rate but no cross-license with an agreement with a lower royalty rate and a valuable cross-license). While controlling for such differences is technically feasible, it requires extremely complex econometric analysis.

In addition, there seems to be no convincing reason why licensors should be prohibited from charging higher rates ex post than ex ante. First, there may be a problem of incomplete contracting.[61] When parties contract for a licence, they may not have a complete view of the commercial applications of the technology at hand, which may only be realized at a later date. Thus, the full commercial potential of a technology can be highly uncertain when the contract is entered into. While the licensor and licensee can attempt a flexible contract in recognition of this uncertainty, foreseeing all future contingencies is an unattainable goal.[62] As a result, ex post contracts may be more efficient in that they incorporate a clearer understanding of the technology and the market in which it will be deployed and thus avoid multiple renegotiations. Forcing essential patent holders to charge similar rates ex ante and ex post would deprive them of the ability to give preferential terms to early adopters of their technology, although it has been argued that

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[61] See generally Patrick Bolton and Mathias Dewatripont, *Contract Conjecture*, The MIT Press, 2005.

[62] See, e.g., Oliver D. Hart & John Moore, "Incomplete Contracts and Renegotiation", (1988) 56 *Econometrica* 755; Eric S. Maskin & John Moore, "Implementation and Renegotiation", (1999) 66 *Rev. of Econ. Studies* 39; and Philippe Aghion, Mathias Dewatripont & Patrick Rey, "Renegotiation Design with Unverifiable Information", (2004) 62 *Econometrica* 257

preferential treatment may not survive a non-discrimination analysis.[63]

A third benchmark to assess whether the royalty rate sought by an essential patent holder is fair and reasonable is based on the determination of whether that rate is in line with the rate that would have prevailed from ex ante competition between its technology and alternative technological solutions. This method essentially relies on the Swanson and Baumol model.[64] In this model, SSOs organize an auction-like process for the selection of technologies to be embodied in a given standard whereby the owners of competing technologies offer bids of a license fee per unit of output to downstream users who are selecting which technology should be embodied in a given standard.[65]

In that simplified scenario, there are two competing technologies A and B, owned by firms A and B respectively, with different cost implications for downstream firms. The best technology option is A, which would result in downstream production costs of 5 per unit of output. Use of B would result in downstream production costs of 6. If the above information is known and A and B compete to be selected by offering per unit license fees, A will offer a license of 1 per unit of output and be chosen. That is because under Bertrand competition, A and B will compete each other down to marginal costs (which, in the case of IPRs, is equal to zero), and A will only be able to charge a license fee equal to the incremental value of its technology as compared to the competing alternative (i.e., B). Thus, under this model, when the difference in incremental value between

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[63] See Gilbert, supra note 25.

[64] See Swanson & Baumol, supra note 26.

[65] Damien Geradin et al., "Competing Away Market Power? An Economic Assessment of Ex Ante Auctions in Standard Setting", (2008) 4 *European Competition Journal* 443.

technologies A and B is large, the license fee will be high, whereas when A and B are close or perfect substitutes, the licensee fee will tend to zero.

The appropriateness of Swanson and Baumol's auction-type model is, however, questionable for several reasons. First, this model relies on a number of simplifying assumptions: (i) the two firms (A & B) competing to have their technologies included in the standard are not vertically integrated; (ii) the offerings of these two firms does not differ on quality (but only in the cost implications for production); and (iii) bargaining power is evenly distributed across parties as no one SSO member or contingent of members is able to control or bias the vote. In reality, however, non-integrated firms and firms with both IPRs and manufacturing interests compete to see their technologies adopted by SSOs, and their offerings often differ in quality. Member firms also clearly differ in their bargaining positions. As Layne-Farrar, Padilla and I have demonstrated else-where, the presence of such asymmetries between parties/technologies has important implications along a number of dimensions for the use of ex ante auctions in standard-setting.[66] For instance, the presence of asymmetric bidders (i.e., firms with different business models) has serious implications for how an ex ante auction process would work. The dual role of vertically integrated companies in the standard-setting process—as innovators and users—will indeed place them at a competitive advantage in an ex ante auction, which may thus result in inefficient outcomes.[67] Unfortunately, a number of authors have

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[66] Id.

[67] For instance, these companies may afford to set very low royalty rates because they have the option to fund their investment with downstream profits. As a result, SSOs may end up selecting the technologies owned by vertically integrated companies even when those technologies are not the most valuable. Furthermore, non-integrated companies may have to bid very low to match the terms offered by their vertically integrated

relied on the Swanson and Baumol model without taking into account the fact that this model is based on a number of assumptions that cannot be verified in practice and, thus, render it of limited relevance in real life situations.[68] This is particularly dis-concerting since Swanson and Baumol recognized the limitations of their models.

Second, the use of ex ante auctions in standard-setting contexts to determine what a reasonable royalty should be may result in serious under-compensation of productive investment and innovation. Even in the simple model developed by Swanson and Baumol, where none of the asymmetries and problems listed above applies, the payment received by the winner of the ex ante auction – company A – may not be enough to properly compensate the investment costs incurred in developing its superior technology. Indeed, company A receives a payment equal to the incremental value of its technology relative to the next best option plus the recurring cost of licensing to third parties. But such an amount may or may not exceed its R&D costs (plus an adequate rate of return that takes into account the risky nature of its investment). Consequently, even in the basic setting analyzed by Swanson and Baumol the ex ante auction may under-compensate innovation, something that these authors once again acknowledge in their paper.[69]

The above discussion shows that there are no obvious mechanisms or benchmarks that can be used to determine ex post whether

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counterparts, which may reduce their incentives to innovate and participate in the cooperative standardization process, and may even force them to exit the relevant innovation market.

[68] George S. Cary, Larry C. Work-Dembowski, & Paul S. Hayes, "Antitrust Implications of Abuse of Standard-Setting", 2008) 15 *Geo. Mason L. Rev.* 1241.

[69] See Swanson & Baumol, supra note 26, at 11.

the royalty charged by an essential patent holder is "excessive" or "unfair." Moreover, the common thread between these benchmarks is that they would generally make essentially patent holders worse off, hence, with the risk they produce reverse patent hold-ups.

C. Use of Competition Rules to Force Essential Patent Holders to reduce their royalties

In addition to the standard implementers' broad efforts to reduce the bargaining power of essential IP holders and thus their ability to monetize their patent portfolio, some such implementers decided to rely on EU competition rules to seek remedy against what they claimed to be anti-competitive conduct by essential patent holders. This led the Commission to open several investigations. For instance, in the *Qualcomm* case, six firms active in the mobile phone equipment sector filed complaints with the European Commission in the latter part of 2005 alleging that Qualcomm's licensing terms and conditions for its patents essential to the WCDMA standard did not comply with Qualcomm's FRAND commitment and, therefore, breached EU competition rules.[70] The complainants claimed that Qualcomm should not be entitled to exploit the extra market power it had allegedly gained as a result of having technology based on its patents incorporated in the standard.

After a long and thorough investigation, the Commission eventually decided to close its formal proceedings against Qualcomm,[71] hence following the very cautious approach it has usually taken in excessive pricing cases. This case, however, clearly illustrates the considerable difficulty for the Commission (but it is also true for any

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[70] See supra note 2.

[71] "Commission closes formal proceedings against Qualcomm", MEMO/09/516, 24 November 2009.

other competition authority) to determine whether the royalty rates sought by an essential patent holders are "fair and reasonable" or "excessive" under the standard set by the European Court of Justice in *United Brands*.[72] While determining whether the price of a physical product is excessive is already difficult, that task is even more complex with respect to non-physical constructs, such as IPRs. Although the complainants proposed a number of benchmarks to determine whether Qualcomm's royalties were "fair and reasonable" (some of which were discussed above (see Section 6.4.B), we have seen that these benchmarks suffered from major weaknesses either because they were theoretically unsound or because they would have raised complex implementation issues. In the *Qualcomm* case, this exercise was particularly absurd considering that the royalty rates and other licensing terms contained in Qualcomm's licenses had been negotiated at arm's length – in some cases *before* the WCDMA standard was adopted – with large and sophisticated corporations.

The above suggests that, in the absence of an exclusionary behavior, EU competition law is not the right instrument to address

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[72] See ECJ, 27/76 United Brands Company and United Brands Continentaal BV v Commission [1978] ECR 207. In United Brands, the ECJ suggested that a two-stage test would be required to assess whether prices were excessive. First, a comparison between the selling price and production costs would be used to reveal the profit margin. Although the court did not suggest the level at which the profit would become excessive, it found that the Commission had failed to examine United Brands' cost structure. Second, prices charged by the dominant firm would be compared to those of competitors' products. The ECJ also noted that many ways could be devised to determine whether a price was unfair. For the difficulty to apply the United Brands test to IPRs, see Damien Geradin, "Abusive Pricing in an IP Licensing Context: An EC Competition Law Analysis", in C.D. Elhermann and M. Marquis, European Competition Law Annual 2007: A Reformed Approach to Article 82 EC, Hart Publishing, 2008

hold up cases allegedly committed by essential patent holders. The Commission and other antitrust authorities are simply poorly equipped to act as price regulators and they should thus not engage in such direction.[73] Perhaps for this reason, during the *Qualcomm* investigation, Commission officials indicated on a number of occasions that it was preferable to prevent abuses by IPR holders from occurring, rather than addressing such abuses ex post through the application of EU competition rules.[74] This seems to be the approach followed by the Commission in its recently released draft guidelines on horizontal cooperation agreements.[75] In order to address the alleged exploitative behavior that may occur in the context of standardization, the draft guidelines provide that all SSOs should adopt "binding" rules on their members "to avoid the misuse of standardization process through hold-ups and charging abusive royalties by IPR holders."[76] While these draft guidelines will likely evolve in the months to come, they clearly indicate a desire on the part of the Commission to adopt a preventive approach to possible standard abuses.

Of course, it could be claimed that legal redress should be available to licensees when the licensing terms proposed by a

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[73] In this respect, an additional danger for the Commission to create a precedent is that it would likely trigger an array of claims made by infringers that the licensing terms proposed by the patent holder are not FRAND and thus violate Article 102 TFEU.

[74] See, e.g., Neelie Kroes, "Being Open About Standards", OpenForum Europe - Breakfast seminar, 10 June 2008, Brussels, available at http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/08/317.

[75] "Commission consults on review of rules applicable to horizontal co-operation agreements", IP/10/489, 4 May 2010.

[76] Draft guidelines on horizontal co-operation agreements, supra note 34, at para. 275.

potential licensee are not FRAND. As the author of this note has explained in greater detail elsewhere, in such circumstances the standard implementer may simply wait and assert defensively that the IP owner has failed to satisfy its obligation to offer FRAND terms, or (under the procedure appropriate in a given jurisdiction) proactively seek a determination that FRAND terms have not been offered, and an order requiring compliance with that obligation.[77] In order to determine whether offered terms and conditions pass the "range of reasonableness" that is comprised in the FRAND concept, there is no reason that courts should not make use of analytical tools already existing in the law.

For instance, while the question of what is "reasonable" continues to be a flexible inquiry, the much-cited *Georgia-Pacific*[78] case identifies 15 specific factors that U.S. courts routinely consider, and the factors from the *Georgia-Pacific* list have been invoked as useful in other jurisdictions. Not all of the *Georgia Pacific* factors will necessarily be relevant to the question of whether proffered license terms are within the range of reasonableness and peculiarities of a particular industry or standardized industries in general may properly enter into the equation. Nevertheless, a court may well find that the *Georgia Pacific* list provides a useful framework or starting point for the inquiry.[79] Notably, royalties received under prior and existing licenses for the very patents being litigated often represent the most

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[77] See Geradin and Rato (FRAND Commitment and EC Competition Law), supra note 2, at 119.

[78] *Georgia-Pacific Corp. v. U.S. Plywood Corp*., 318 F. Supp. 1116 (S.D.N.Y. 1970).

[79] At least one U.S. court has adopted the Georgia-Pacific factors to assess the reasonableness of a licensing offer challenged on FRAND grounds, see *ESS Tech., Inc. v. PC–Tel, Inc.*, No. 99-CV-20292, 2001 WL 1891713, at *3–6 (N.D. Cal. Nov. 28, 2001).

influential factor in determining "reasonableness" under the *Georgia-Pacific* framework, and should arguably have the same role in the context of FRAND litigation.

6.5 Conclusions

As this paper has shown, while the economic and legal literature on standardization has vastly exaggerated the risks that would be created by patent hold-up, it has entirely ignored the risks that essential patent holders face from the moment they decide to devote resources to an R&D project to the moment they collect their first dollar on this project.

Innovation is a risky business, even more so when it takes place in standardized fields as technology selection, while essential to standardization, may eliminate the prospect of commercialisation of patented inventions. Moreover, even when a patented technology is selected to become part of a standard, it does not mean that the patentee will be rewarded at a level that (i) covers the sunk costs it incurred in its R&D efforts and (ii) motivates it – or its investors – to engage in future innovative projects. Economic resources (i.e., capital) flow to their highest expected rates of return and it is therefore clear that attempts to reduce the revenues of patent holders will divert resources from innovative projects in standardized fields to more lucrative ventures. The diversion of resources created by regulatory risks is particularly likely to affect complex and speculative innovative activities as investors decide to redirect their investments to less uncertain investments (e.g., easily achievable technological improvements, etc.).

A related risk is that the efforts undertaken to reduce the revenues of essential patent holders will unjustifiably alter market structure as they will particularly affect firms that have a licensing

business model. That is undesirable for several reasons.[80] First, many such firms (including university research centres, start-ups or more established companies, etc) contribute to a significant extent to innovation. Second, these firms are more likely to license – and thus disseminate – their technologies than vertically-integrated firms, which may seek to restrict their downstream competitors' access to their technologies. Finally, licensing may be an easier path to entry in technology markets than business models based on both innovating and manufacturing and may thus stimulate competition.

[80] Damien Geradin et al., supra note 47.

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