경제학석사 학위논문

Patent Holdup and Royalty Stacking in the Standardization Context

특허억류·실시료 과적 이론과 표준필수특허

2017 년 8 월

서울대학교 대학원

경제학부 경제학 전공

김 성 이

Patent Holdup and Royalty Stacking in the Standardization Context

지도교수 이 상 승

이 논문을 경제학석사 학위논문으로 제출함.

2017년 3월

서울대학교 대학원

경제학부 경제학 전공

김 성 이

김성이의 경제학석사 학위논문을 인준함.

2017년 6월

위 원 장 조 성 진 (인)

부위원장 이 상 승 (인)

위 원 **Yves Gueron** (인)

Patent Holdup and Royalty Stacking in the Standardization Context

Sungyee Kim
Department of Economics
The Graduate School
Seoul National University

Abstract

The aim of this paper is twofold. First, to discuss the general framework of the patent holdup and royalty stacking theory. Second, to extend the analysis to the context of standard-essential patents (SEPs). I propose a modified version of the Lemley-Shapiro holdup model and show that the injunction threat can lead to higher royalty overcharge in the case of SEPs and that the downstream firm could favor a (socially undesirable) inferior technology due to the risk of holdup. I show that requiring ex ante commitments on royalty rate can help mitigate such negative consequences. The price cap policy can guarantee the selection of a superior technology, and the FRAND obligation can guarantee a reasonable rate of compensation. Providing clearer and stricter guidelines on disclosure requirements thus can be useful in weakening the bargaining power of SEP holders. As there is limited data on royalty rates and licensing terms, further research is needed to demonstrate the existence and significance of the patent holdup and royalty stacking phenomena.

Keywords: standard-essential patent, patent holdup, royalty stacking, FRAND commitment, royalty cap

Student number: 2015-22506

Contents

List of Figures

I. Introduction

Recently, the number of patents and patent holders has grown dramatically worldwide. The World Intellectual Property Organization (WIPO)'s PCT patent filings has increased by more than 47% over the last decade in the fields of electrical engineering alone.[1] As innovation and commercialization are closely linked to intellectual property especially in high-technology industries, there has been growing debate on how to best operate the patent system and achieve a proper balance between competition and patent protection.

Lemley and Shapiro (2007a) is one of the first theoretical work to analyze the potential problems associated with intellectual property rights ("IPRs"), namely, patent holdup and royalty stacking. IPRs grant their owners a temporary "legal monopoly," allowing them to prevent other parties from making unauthorized use of their intellectual property. The Lemley-Shapiro model identifies the patent owner's right to obtain an injunction against infringement to be a powerful weapon in a negotiation. Yet, such exclusive nature of property rights does not necessarily entail market power, because "if close substitutes exist for a patented product, the patent may confer little power over price" (Posner, 2005, p. 68). The "legal monopoly" would only imply an "economic monopoly" if there is no existing alternative or switching to another technology incurs substantial costs. In complex industries, innovation often requires making technology-specific investments and having access to an overlapping set of patent rights. If innovators were to switch away from an adopted technology or standard, they would have to abandon their previous investments and pay additional costs to navigate through patent thickets (to avoid potential antitrust issues) and design, manufacture, sell, and service a new product.

[1] See WIPO's yearly reviews (2006, 2016) for more information. The PCT international applications in the electrical engineering field (including digital communication and computer technology) were 50,109 and 73,931 in 2006 and 2016, respectively (the total applications were 147,500 and 233,000, respectively). The recent patent growth is largely driven by China, which is expected to surpass the U.S. within two years as the leader of the patent system.

In this paper, I examine such circumstances when patent protection confers negotiating leverage on patent owners, which may allow them to "hold up" and "stack up" royalties and force the implementer to comply with licensing terms otherwise unacceptable.

Scholars claim that the two issues are particularly problematic with regard to standard-essential patents ("SEPs"). As downstream firms cannot design around SEPs if they were to use standardized technologies, an SEP owner can charge excessive royalties based on the value of the standard itself. When there are multiple SEP holders, they each can demand a royalty without considering the negative externality they impose on each other, resulting in multiple mark-ups of royalties. In order to estimate the severity of royalty overcharge in the case of SEPs, I introduce a modified version of the Lemley-Shapiro holdup model, which assumes that there are several patented alternative technologies and that redesign is impossible. The model confirms that the holdup problem is exacerbated in the context of SEPs and shows that the downstream firm could thus be motivated to choose an inferior technology for its product. I examine how patent holders' ex ante commitment on royalty rates can mitigate such problems and lead to a more "socially desirable" outcome. The royalty cap policy is compared with the FRAND obligation to determine which method can better serve the patent system in the standard-setting context.

In reality, however, there is little evidence that the patent holdup and royalty stacking phenomena actually exist. Critics claim that they are simply theoretical issues, as the interaction of various market responses could serve to ameliorate the adverse effect said to arise in the patent system. Firms often voluntarily enter into licensing arrangements—such as cross-licensing, research joint ventures, and patent pools—to simplify negotiation and reduce aggregate royalty rates. Whether these vertical and horizontal restraints are sufficient to resolve the patent problems is uncertain and requires further research. It has been difficult for scholars to test the theory empirically due to inadequate, often confidential, data and inherently dynamic nature of complex industries.

The remainder of the paper is structured as follows. Part II gives a detailed literature review on the patent holdup and royalty stacking theory (see Golden, 2007; Lemley and Shapiro, 2007b; Sidak, 2008; Elhauge, 2008; Farrell and Shapiro, 2008; Geradin, Layne-Farrar, & Padilla, 2008; Layne-Farrar, 2014; Galetovic and Gupta, 2016). Part III examines the scope and severity of the two phenomena in relation to essential patents and discusses the role of SSO rules in preventing SEP holders from exploiting their negotiating power. In Section III.C., I use the modified Lemley-Shapiro holdup model to study the bargaining game and analyze the effectiveness of ex ante policies. Part IV concludes.

II. An Overview of the Patent Holdup and Royalty Stacking Theory

II.A. Patent Holdup

II.A.a. Surprise Patents: Threat Points and Benchmark Royalty

With the growth of patent thickets, it has become more challenging for manufacturers to navigate and identify what relevant patents are necessary for a particular innovation. Since hundreds and thousands of patents are incorporated into developing a high-technology product, it is possible that an innovator infringes on a patent unknowingly or that a patent owner strategically publishes or issues a related patent after the innovator has made irreversible investments. Downstream implementers then could be forced to pay a royalty for a patent hat could easily have been designed around or negotiated through a more competitive process only if they had known earlier that such patent existed or was pending. I focus on such “patent ambush” scenarios in this section.

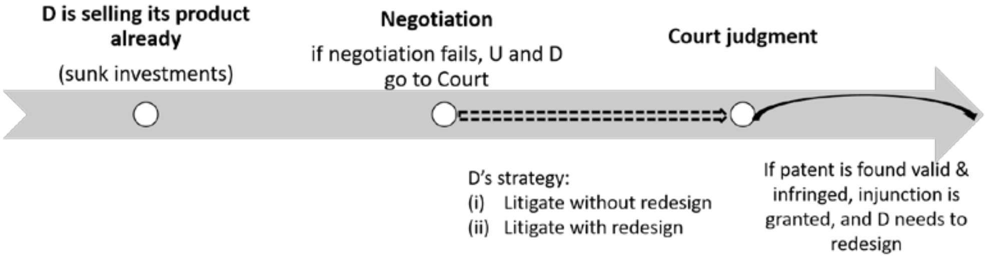

Figure 1. Timeline of the Lemley-Shapiro holdup model. This figure shows how the upstream and downstream firms interact in a licensing negotiation.

To understand how agents make royalty decisions in a Nash bargaining framework, one needs to consider the *threat points* in a negotiation. That is, the solution depends on the parties' payoffs when the negotiation ends in disagreement. When the downstream firm is made aware that its product infringes on a patent after it has made investments to manufacture and sell the product, it faces three options: sign a licensing agreement, design around the patent, or take no action. I assume that the expected gains from litigating is greater than litigation costs for the patent owner so that if the downstream firm fails to negotiate or to make changes to the design, the patent holder will surely bring an infringement action.[2] If the Court decides that the patent invalid and uninfringed, the downstream firm can continue selling its product without any licensing obligation. If the patent is found valid and infringed, however, and the patent holder is granted with the right to an exclusion order, the manufacturer not only suffers from monetary penalties (such as damages) but also faces the risk of shutdown until it could develop a non-infringing version of its product.[3] As an injunction can permanently prohibit the manufacture, use, sale, or distribution of products using the infringed patent, the mere threat of the remedy can

[2] See Appendix of Shapiro (2010) for more information on when litigation is the optimal strategy for the patent holder.
[3] Damage are monetary compensation for injury to a person, property, or reputation. In the U.S., the court could award up to treble damages if it finds willful infringement. The innovator also could be responsible to pay for the patent holder's court costs and attorney's fees.

be a strong bargaining chip for patent owners.[4] With such costly outside option, the downstream firm could find agreeing to unreasonable licensing terms to be less risky than pursuing litigation, allowing the patent owner to reap payments in excess of the value it actually contributes to the product. In fact, earlier studies find that "patent litigation is largely a settlement mechanism" in reality (Kesan and Ball, 2006, abstract). Most patent disputes are resolved with settlements or with summary judgments before reaching trial, possibly due to the costly, lengthy, and unpredictable consequences of going to court and the difficulties involved in determining whether a patent is valid or essential. [5]

To identify the level of royalty overcharge driven by the injunction threat, one needs to determine the benchmark royalty rate that reflects the outcome of a bilateral negotiation in the absence of ex post licensing problems such as holdup and stacking. For simplicity, normalize patent life to 1 and define $M \equiv P - C$ to be the per-unit margin from selling a unit of product with the patented feature. Let X be the total number of units produced by the manufacturer, and suppose X is independent of whether or not the patented feature is included in the product. Lemley and Shapiro (2007a) define the benchmark payoff to a patent holder to be $B\theta VX$, with V being the marginal value of the patent compared to the next best non-infringing alternative,

[4] Before 2006, courts routinely granted permanent injunctions to patent owners when their patents were proven valid and infringed. Since the Supreme Court's decision in eBay v. MercExchange, courts have employed a four-factor test to decide whether to award injunctive relief. The test requires a plaintiff to demonstrate: (1) that it has suffered an irreparable injury; (2) that remedies available at law are inadequate to compensate for that injury; (3) that considering the balance of hardships between the plaintiff and defendant, a remedy in equity is warranted; and (4) that the public interest would not be disserved by a permanenting junction. The full text of the decision is available at https://www.supremecourt.gov/opinions/05pdf/05-130.pdf.

[5] Kesan and Ball (2006) examine 5,207 lawsuits filed in 1995, 1997, and 2000 and find that only 5% of patent cases actually go to trial, and about 6-9% of cases are terminated with a summary judgment. They note that "if a summary judgment on the issue of infringement or invalidity was rendered and the case terminated immediately, that case was viewed as terminating with a pre-trial ruling. However, if a summary judgment was a partial summary judgment or was followed by pre-trial conferences and the like, and then a settlement occurred, the case was classified as a settlement" (p. 267).

θ being the patent strength (i.e. the probability that it will be found valid and infringed), and B being the bargaining skill of the patent holder.[6] The model assumes that the three variables are independent.

Since fairness and reasonableness are abstract concepts, there could be a wide range of fair and reasonable royalty rates and licensing terms. Critics of the Lemley-Shapiro model claim that a reasonable royalty should fully compensate the upstream firm for the patented feature's (expected) social contribution, as patent owners are not obliged under the patent law to set low royalties for the benefit of implementers and consumers.[7] Sidak (2008) claims that a patent holder faces a *first-mover disadvantage* because it "cannot recover the resources invested in a failed sunk-cost investment and shift them to an alternative project," whereas a downstream innovator can "wait and see" whether the patented technology is worthy of use (p. 739). Golden (2007) and Elhauge (2008) hence suggest that the benchmark royalty level should be θV, which captures the value of the patented feature itself and better preserves the incentives of patent owners to invest, innovate, and contribute to technology standards.[8]

Yet, within the Nash bargaining framework, B should be included in the benchmark to describe how the total gains from trade are split between the negotiating parties in equilibrium. Lemley and Shapiro (2007b) emphasize that "market outcomes routinely depend upon bargaining skills whenever there are gains from trade that are unique to a buyer–seller pair" (p. 2165). The parties' bargaining

[6] As validity is measured against obviousness or prior art, there is uncertainty about the litigation outcome: "[weak patents] may well be invalid, but nobody knows for sure without conclusive litigation" (Farrell and Shapiro, 2008, p. 1347).
[7] Sidak (2008) notes that "the benign owner of a patent that confers monopoly power is not obligated by antitrust law to refrain from exploiting its power over price. Section 2 of the Sherman Act does not transform the owner of a valuable patent into a public utility—nor, for that matter, does any provision of patent law" (p. 717).
[8] Golden (2007) and Elhauge (2008) claim that even θV does not fully capture the social value the patented invention because it ignores the value created after the patent term expires. Yet, given rapid technological change in complex industries, the patent value is likely to diminish over time, and the patent term of 20 years in the U.S. could be sufficient to compensate for its social contribution.

power would reflect their underlying interests and needs in negotiation and their strategic advantages before facing the risk of holdup and stacking. One should note that if $B = 1$, as the upstream firm would reap all of the social value generated by the licensing agreement, the manufacturer may as well prefer to abandon the use of the patented feature altogether or to invent its own technology. Also, the actual contribution of the patent could be smaller than its expected value because it is often the case that the downstream firm has been developing a similar technology independently before realizing that a relevant patent already exists.[9] Hence, the downstream firm would have the incentive to engage in licensing only if it could generate some revenues from using the patented technology.

II.A.b. The Lemley-Shapiro Holdup Model

The Lemley-Shapiro holdup model illustrates that in all cases, the negotiated royalty would exceed the reasonable benchmark level due to the risk of facing an injunction. For simplicity, assume complete information in modeling the bargaining game.[10] Suppose it takes $0 \leq T \leq 1$ to reach a court decision and $L < 1 - T$ for the manufacturer to redesign its product. If the Court finds the patent to be valid and infringed, the downstream firm has to pay for damages incurred during $[0, T]$, and the upstream firm is able to obtain an injunction that would be effective from T forward. Lemley and Shapiro (2007a) claim that the Court would typically award

[9] Lemley and Shapiro (2007b) mention that “the patent holder’s social contribution does not include use of the patented invention by the party that independently achieved the same invention” (p. 2166).

[10] In the real world, it is unlikely that the negotiating parties have full knowledge of the facts. Patent holders could have imperfect information on variables related to downstream firms, such as redesign costs, sales loss, and profit margins. Similarly, downstream firms could lack information on patent strength and validity. I assume that such information asymmetry still leads to efficient outcome because if the negotiated royalty rate is “higher than the full information rate, the infringer would improve her outcome by fully revealing her position to the patent holder,” and vice versa (Sidak, 2008, p. 745).

$S = BV$ as per-unit damages because this is the reasonable royalty that would have been negotiated ex ante if the patent were *known* to be valid.

The downstream firm can pursue two hypothetical strategies when negotiation breaks down. First, it could continue operating without redesigning its product, as shown in Figure 2. Here, "redesigning" means that the manufacturer is removing the patented feature from its product design; if the redesign is successful, the manufacturer earns $M - V > 0$ from a unit of sale. This scenario is more probable when (a) the redesign cost is relatively high or (b) the patent is relatively weak, thus having a low chance of finding infringement in litigation. The model predicts that in such cases, the percentage gap between the negotiated royalty and the benchmark $B\theta V$ is $C + \frac{M-V}{V}L$ per unit, in which the first term is the measure of duplicative design costs (relative to patent value) and the second term is the profit loss (relative to lifetime sales) during the lag period the firm is forced out of market.[11] In other words, as the negotiating parties can anticipate the fixed cost and the lag time that would be necessary to redesign the product if the downstream firm loses the suit, the patent holder is able to demand compensation greater than what it could have achieved if the downstream firm has not yet developed the product. Note that another way to represent the percentage overcharge is $\frac{\pi^N - \pi^B}{\pi^B}$, in which π^B is the patent holder's profit at the benchmark level, and π^N is its profit at the negotiated royalty level.

[11] Shapiro (2010) defines C to be $\frac{F}{VX}$, in which F is the fixed redesign costs. If the injunction is obtained, the downstream firm is driven out of the market and has to spend F to change its product design. Only after the redesign, the downstream firm is able to earn $(1 - T - L)(M - V)X$. Hence, in the initial negotiation, assuming Nash bargaining, the upstream firm is able to capture $B\theta\big[(1 - T)MX - [(1 - T - L)(M - V)X - F]\big]$ from the injunction remedy and $T\theta SX$ from the damage remedy, where $S = BV$. In sum, the negotiated royalty is $B\theta V\left(1 + C + \frac{M-V}{V}L\right)$.

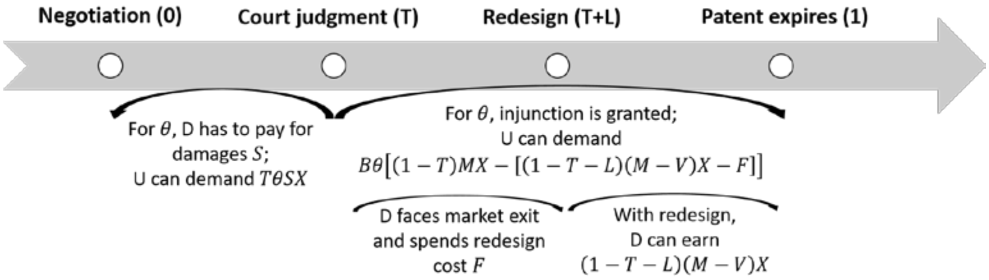

Figure 2. Timeline of events if the downstream firm litigates without redesign. This figure illustrates how the patent holder can charge an excessive royalty in the shadow of an injunction.

On the other hand, the downstream firm could develop a new product design immediately after negotiation breakdown to avoid the risk of shutdown, as shown in Figure 3. This scenario is more probable when (a) the redesign cost is relatively low or (b) the patent is relatively strong, thus having a high chance of proving infringement.[12] In those cases, the predicted percentage gap is $C/_{\theta}$, i.e. the redesign costs multiplied by the inverse of patent strength.[13] This reflects the probability of the downstream firm spending "wasteful" design costs in case the patent is found invalid and uninfringed. In both strategic situations, the level of royalty overcharge is based on how much the downstream firm is willing to pay to avoid an injunction. The model predicts that the patent owner is able to overcharge more for a weak and minor patent (i.e. small θ and V) covering "a complex, profitable, and popular product," because the manufacturer is faced with the risk of losing a greater profit

[12] Golden (2007) notes that legal costs (i.e. court costs and attorney's fees) would "add to the overall expected cost of the litigation option, providing greater incentive for a design-around and greater leverage to the patent holder" (p. 2126).

[13] In this scenario, the downstream firm spends F regardless of court decision. If the patent is valid, the downstream firm has to pay for damages incurred during $[0, T]$. If the injunction is obtained, the downstream firm is only able to earn $(1-T-L)(M-V)X$. Hence, assuming Nash bargaining, the upstream firm is able to capture $B\theta\big[(1-T)MX-[(1-T-L)(M-V)X]\big]$ from the injunction remedy, $T\theta SX$ from the damage remedy, and BF from the fact that the downstream firm would have to spend sunk redesign costs if the initial negotiation fails. In sum, the negotiated royalty is $B\theta V\left(1+\frac{C}{\theta}\right)$.

margin (Lemley and Shapiro, 2007a, p. 1993). Advocates of the patent holdup theory thus argue that, given the dramatic increase in the number of patents, the patent system should limit the issuance of injunctions in patent infringement cases and that competition agencies should keep a close eye on potentially excessive royalty charges.

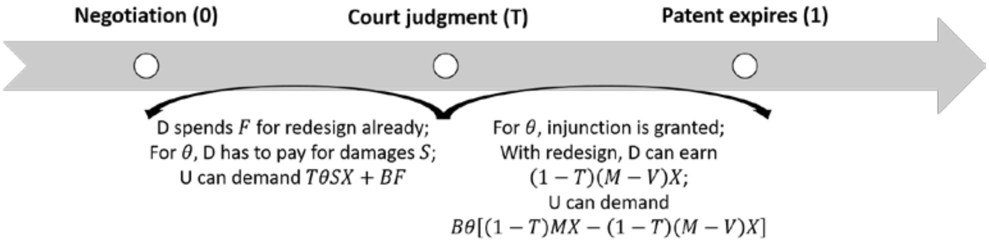

Figure 3. Timeline of events if the downstream firm litigates with redesign. This figure shows that the downstream firm is willing to pay an excessive royalty to avoid market withdrawal when an injunction is obtained.

II.A.c. Multiple Firms and Repeated Games

The patent holdup theory is based on a strong assumption that the injunction threat grants significant leverage to the patent holder and that the downstream licensee has no other viable option than accepting the licensing terms. The model becomes more complex when there are multiple agents in the market and when negotiation is sequential and repeated, because pursuing litigation could have further consequences and implications.

Suppose there are several potential implementers in the downstream market. In the perspective of a downstream firm, challenging the patent owner would benefit all implementers but incur litigation costs only to the one who brings the suit. To avoid having to bear the additional expenses alone, each firm could find resolving through negotiation and settlement to be a safer option than pursuing litigation. Such free-riding problem could also discourage the formation of a joint defense group because each infringer would hang back from devoting any effort and hope that some other firm will bear the burden. Then, in one-shot interactions, as examined in the

Lemley-Shapiro model, the patent owner might be able to act opportunistically and demand excessive rewards from all infringers. Yet, if licensing negotiation takes place on a repeated or sequential basis, some firms may find it more profitable to pursue a legal action for "some unaccounted-for benefits…such as maintaining a reputation for hard bargaining," which could help in future negotiations and litigations (Golden, 2007, p. 2126).[14]

In the perspective of a patent holder, winning an infringement lawsuit could strengthen its bargaining position against all downstream firms. A court judgment that its patent is valid and infringed could lead to an overall increase in royalty rates. Conversely, if the patent holder loses a legal dispute, there is the increased risk that "royalties from other downstream firms will be reduced or eliminated" (Lemley and Shapiro, 2007a, p. 2016). Several empirical studies show that, as one court decision could strongly influence subsequent negotiations, patent holders are more likely to settle their most-litigated (thus most cited and valuable) patents before judgment.[15] Furthermore, if the downstream firm also owns patents that could be used to bring a counterclaim, the parties could use the patents defensively to avoid lawsuits (which could lead to a mutually-destructive outcome) and to facilitate settlement possibly through cross-licensing.[16] Since firms negotiate repeatedly in the real world, they have the incentive to cooperate and reach a jointly-optimal outcome because any deviation could trigger punishments in the following rounds. As the "legal monopoly"

[14] I examine in Part III how downstream firms could engage in "reverse holdup," or "holdout," when the patent holder's proprietary rights are restrained by SSO rules.

[15] The surprising result of Allison et al. (2011) is that "most-litigated patents that go to judgment are far more likely to be held invalid or not infringed. The differences are dramatic. Once-litigated patents win in court almost 50% of the time, while the most-litigated—and putatively most valuable—patents win in court only 10.7% of the time" (p. 680).

[16] Cross-licensing refers to a contract signed by two or more agents where there is a mutual exchange of patent rights. Firms often enter into such arrangement to avoid the threat of litigation or to settle a patent dispute. Cross-licenses are often viewed to provide procompetitive benefits, but some critics argue that "patent-rich firms [may] favor one another and exclude patent-poor firms," which may be anticompetitive in the context of standardization (Farrell et al., 2007, p. 640).

granted by the patent is only temporary, continuous interaction between and across parties could pressure the patent holder to set sensible licensing terms and maintain its reputation as a reliable partner.[17]

In the next section, I discuss how the presence of multiple patent holders can affect the outcome of individual negotiation and relates to the problems of patent holdup and royalty stacking.

II.B. Royalty Stacking

II.B.a. Relationship Between Holdup and Stacking

Royalty stacking is an example of the complements problem first identified by Cournot (1838). He observed that when complementary inputs are controlled by separate and independent suppliers, the cumulative input price is higher than the price imposed by a single supplier controlling all inputs because each pricing decision is made without regard to its effect on the demand for others.[18] In our context, since patents are complements from the implementer's standpoint, a series of bilateral licensing negotiation could lead to an aggregate royalty burden that far exceeds the level of compensation that would have been negotiated by a patent monopolist. This could lead to a socially undesirable outcome in which the patent holders extract most, if not all, of the downstream firm's profit margin.

Both patent holdup and royalty stacking theories are based on the implicit assumption that patent holders have some bargaining power to seek supra-competitive rewards. Yet, one needs to be cautious about establishing a relationship between the two phenomena. The stacked royalty level is not as simple as combining

[17] Geradin et al. (2008) comment that "firms gaining a reputation for this kind of tactic will face stronger opposition on the next version of the standard because rival firms are reluctant to accept their technological suggestions or have invented around their technology to preempt any future holdups" (p. 165).
[18] An integrated firm would internalize the negative externality and thus have a lower incentive to increase prices.

individual royalties driven by multiple holdups. In fact, each patent holder's ability to capture rents would decrease when there are several upstream firms ("rent-splitting"). The intuition is as follows: as there are other rent-seeking patent holders, there is a smaller residual margin from which a patent owner can collect a reward, and as the downstream firm has lower stakes at risk from entering into patent litigation, the royalty each patent owner is able to demand is adjusted downward (Lemley and Shapiro, 2007a, p. 2012). Specifically, in the "litigate" scenario, the amount of percentage overcharge decreases as M declines, because the injunctive remedy becomes less threatening to the downstream firm. Patent holders themselves could refrain from demanding a reward substantially above the patent value as it is not in their interests to drive downstream firms out of the market.

Although the negotiating power of an upstream firm may be affected by the presence of other patent holders, royalty stacking can occur as long as (a) the negotiated royalty rate stays above the hypothetical benchmark and (b) numerous patents are involved. Note that even if each patent holder demands what appears to be a reasonable payment from its standpoint, the royalty fees could stack up beyond the fair and reasonable range acceptable to the downstream firm. Such excessive royalty accumulation could have industry-wide consequences. With the increased royalty burden, the manufacturer could "pass through" some of the costs to its consumers by raising prices.[19] If pass-through is incomplete, the manufacturer with a low profit margin would be unable to make necessary investments to innovate, develop, and sell products in the long run, which could discourage innovation and competition in the downstream market. The growing number of patent owners in

[19] Sidak (2008) notes that "higher royalty rates for producers [may] be passed onto consumers, depending on the relative elasticities of demand and supply" (p. 733). Galetovic, Haber, and Levine (2015) also acknowledge that "the manufacturer must either accept lower profit margins, with concomitant reductions in research and development (R&D) spending for future rounds of innovation, or pass these additional costs on to consumers" (p. 557).

complex industries thus could suggest that there is increasing inefficiency in the downstream market with high prices and low sales.[20]

II.B.b. The Basic Model of Royalty Stacking

This section reviews Lemley and Shapiro's (2007a) simplified royalty stacking model to discuss the underlying mechanism and the economic implications of the theory.[21] The model is a two-stage game: in the first stage, the optimal royalty rates are negotiated in the upstream market, and in the second stage, the final quantity is decided in the downstream market. There is a single downstream firm that produces at a positive margin and faces a linear demand, $X = A - P + V$, with $V = \sum_{i=1}^{N} v_i$ being the value of $N > 1$ independent patents that are essential for the production of X. Throughout this paper, assume no fixed costs or capacity limits and normalize marginal cost to C. First consider the case in which there is a single upstream firm (not integrated with the downstream firm) that controls all N patents and sets a simple, per-unit royalty R.[22] This is considered our benchmark royalty because an ideal licensing negotiation should take into account the royalty payments for other patents reading on the same product, as in the Court complements problem. If the downstream firm decides to accept the licensing proposal rather than litigate or redesign, its profit maximization problem is given by $\max_{P}\ (P - C - R)(A - P +$

[20] I later examine in Part III how the problems of holdup and stacking are amplified in the context of SEPs because patent holders with the market power conferred by standardization can maintain a strong bargaining position against implementers.

[21] See Lemley and Shapiro (2007a) Appendix A for complete derivation and analysis.

[22] I assume a per-unit royalty throughout this paper for simplicity. Llobet and Padilla (2016) show that a percentage royalty (i.e. ad valorem royalty) is more efficient than a per-unit royalty under Cournot competition because innovators have lower incentives to mark up the end price, mitigating the double-marginalization problem. However, with an ad valorem royalty, as the patent owner takes credit for the value created by other technologies, the downstream firm could be dis-incentivized to innovate and commercialize products.

V), which generates $X^D(R) = \frac{A-C+V-R}{2}$.[23] In the upstream market, the single patent holder tries to maximize $R \cdot X^D(R)$, so the equilibrium royalty should be $R^D = \frac{A-C+V}{2}$ with the double-marginalized output level of $X^D = \frac{A-C+V}{4}$.

Now suppose that patents are each owned by N separate upstream firms and that v_i and r_i are symmetric for simplicity. The second stage is equivalent to the benchmark case. In the first stage however, each patent holder sets a royalty individually and simultaneously to maximize $r_i\left(\frac{A-C+V-R}{2}\right)$. The resulting stacked royalty is $R^S = N\left(\frac{A-C+V}{N+1}\right)$ with the output level of $X^S = \frac{A+V-C}{2(N+1)}$. That is, the aggregate royalty paid under $N > 1$ independent patent holders is equal to the single royalty demanded by a patent monopolist multiplied by the factor $\frac{2N}{N+1} > 1$. This multiplier represents the aggregate royalty overcharge arising from the complements problem. The more gatekeepers exist in the production chain, the more likely the stacked royalty burden goes beyond the benchmark level. The negotiated royalty rate would surely exceed each patent holder's contributed value ($r_i > v_i$) if the value of the final product without the patented feature is sufficiently high ($A - C > v_i$).[24] The model predicts that for a given level of V, the retail price increases with the aggregate royalty as the number of upstream firm increases. As all agents in the industry are worse off in this model, the royalty stacking phenomenon could pose a serious threat

[23] The corresponding downstream profit level is $\frac{(A-C+V-R)^2}{4}$. Elhauge (2008) criticizes that royalty stacking should not take place in the Lemley-Shapiro model because a manufacturer could simply refuse to use the patented technology and earn $\frac{(A-C)^2}{4}$ if $V < R$. However, the manufacturer would not be able to choose such option if the patent is standard-essential and the cost of switching to a non-infringing technology is sufficiently high.

[24] Note that if I define a fair and reasonable royalty to be $B_i\theta_i v_i$ as in the holdup model, in the benchmark case, $\frac{R^D}{N}$ would equal this payment if $B_i\theta_i = \frac{A-C+V}{2V}$. If $B_i\theta_i < 1$, it must be $A - C < V$. When there are multiple upstream firms, the stacked royalty burden would be greater than $\sum_{i=1}^{N} B_i\theta_i v_i$ if $A - C > v_i[(N+1)B_i\theta_i - N]$ for each patent, which is always true if $B_i\theta_i < 1$.

to innovation and competition in both downstream and upstream markets in the long run.

III. Holdup and Stacking in the Standardization Context

In recent years, with the increased importance of SEPs in the Information and communication technology (ICT) sector, scholars have expressed concern that standardization could exacerbate the problems of patent holdup and royalty stacking (see Swanson and Baumol, 2005; Farrell et al. 2007; Geradin et al., 2008; Carlton and Shampine, 2013; Layne-Farrar, 2014; Sidak, 2015a, 2015b; Galetovic et al., 2015; Galetovic and Gupta, 2016; Galetovic et al., 2017). A standard is a technical specification "approved by a recognized body that provides rules, guidelines, or characteristics for activities or their results" (ETSI Guide).[25] It increases efficiency and benefits users by promoting interoperability of system components and by encouraging the use and development of related technologies. The other side of the coin is that upon standardization, SEP owners could achieve sufficient market power and gain an upper hand in negotiation against standard implementers. In the recent case of *Rambus*, the court recognized that a standard-essential technology enjoys a position of dominance over its competitors in the relevant market:

> Before [a standard-setting organization (SSO)] adopts a standard, there is often vigorous competition among different technologies for incorporation into that standard. After standardization, however, the dynamic typically shifts, as industry members begin adhering to the standard and the standardized features start to dominate. [26]

[25] The ETSI drafting rules embrace the formal definition of a standard as "a document, established by consensus and approved by a recognized body, 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" (Derived from ISO/IEC Guide 2:1996, definition 3.2). For more information, see http://www.etsi.org/standards/what-are-standards.

[26] See Rambus Inc. v. FTC, 522 F.3d 456, 459 (D.C. Cir. 2008).

Once a standard becomes widely available, innovators are bound to comply with the standard to achieve compatibility with other products, which makes alternative technologies less attractive even if they serve the same purpose and are equally effective (“lock-in” effect). When the downstream firm is producing a standard-compliant product, its outside option in a negotiation involving an SEP is to switch away from the standard itself, but this is often not feasible after incurring technology-specific investments. Hence, without an adequate constraint on the bargaining power of SEP holders, an SSO member could engage in patent holdup by collecting royalties based on the “incremental market power that inclusion of the technology in the standard confers on [them]” (Carlton and Shampine, 2013, p. 536). As in the notable case of *FTC v. Rambus*, an SEP owner could deliberately conceal its essential patent during the standard-setting process and later seek rewards from the locked-in standard implementers.[27] Farrell et al. (2007) discuss that implementers fearing such patent ambush could “inefficiently delay specific investments or postpone introducing new products,… or to avoid using the best technology because it might be patented,” which goes against the purported purpose of standard-setting to promote innovation and competition (p. 623). The Cournot complements problem would also become more severe in the context of standardization because SEPs are perfect complements and often owned by a large number of firms. The cumulative royalty burden on standard implementers could discourage downstream innovators from adopting a standard and making relevant investments, which would chill future standard-setting efforts and hold back consumers from having the procompetitive benefits of standardization.

With extensive debate on patent problems, standards organizations now enforce a set of rules to facilitate an appropriate compensation mechanism for patent

[27] The Federal Trade Commission (FTC) accused Rambus Inc. of intentionally concealing its patent applications during the standard-setting process and later claiming royalties for those patents. Although the D.C. Circuit ruled in favor of Rambus on appeal, many SSOs have tightened their IPR policies since the *Rambus* case.

owners. In the following sections, the effects of two common SSO requirements are examined: first, standard participants must disclose in a timely fashion any patent that may be essential to the implementation of a standard, and second, they must commit to license their SEPs on fair, reasonable, and non-discriminatory (FRAND) terms.

III.A. Patent Disclosure Requirement

The *Rambus* case showed that failing to disclose essential patents can constitute a fraudulent and deceptive act and can raise anticompetitive concerns. Lack of transparency creates uncertainty and inefficiency in the execution of a standard, likely to increase the costs of search, negotiation, and litigation on both sides. Since the *Rambus* case, many standards organizations require their members to disclose any patent and patent application that may be essential or relevant to the implementation of a standard during the standard-setting process. ETSI specifies in its IPR Policy the obligation of timely and transparent disclosure:

> each MEMBER shall use its reasonable endeavours, in particular during the development of a STANDARD or TECHNICAL SPECIFICATION where it participates, to inform ETSI of ESSENTIAL IPRs in a timely fashion. In particular, a MEMBER submitting a technical proposal for a STANDARD or TECHNICAL SPECIFICATION shall, on a bona fide basis, draw the attention of ETSI to any of that MEMBER's IPR which might be ESSENTIAL if that proposal is adopted. (Clause 4.1)[28]

The disclosure of all relevant intellectual property before the standard is set could help SSOs to "determine whether to adopt a standard, which technologies to incorporate into the standard, and whether particular functionalities should be included or excluded from the standard" (Carlton and Shampine 2013, p. 544). With

[28] From ETSI IPR Policy. http://www.etsi.org/images/files/IPR/etsi-ipr-policy.pdf

a better understanding of the scale and scope of a standard, SSOs are able to ensure a fair and competitive selection process between alternative technologies for inclusion into the standard. Also, as all agents are able to make a reasonable assessment of the cumulative royalty burden before implementation, the parties could engage in a more coordinated pricing scheme.

The Lemley-Shapiro model demonstrates that for non-SEPs, early disclosure and negotiation does not completely eliminate the holdup risk. Suppose the parties negotiate before making technology-specific investments. Since the downstream firm has not finalized its product design, it can easily back out from using the patented feature altogether, which would result in the payoff $(M - V)$ per unit. The downstream firm's agreement payoff is M, so the total gains from trade would be V. Then, assuming Nash bargaining, the negotiated royalty would be BV with a percentage gap of $\frac{1-\theta}{\theta}$. This implies that some royalty overcharge is inevitable for patents with uncertain validity.[29] The overcharge is larger for relatively weak patents, for which the downstream firm's optimal strategy is to use the patented feature even at the risk of infringement, but this leads to the same held-up outcome as in the surprise patent case.[30]

In the context of SEPs, an ex ante negotiation means that the parties negotiate before a standard is formally adopted when alternative technologies are still available. Scholars argue that patent holders would be unable to demand excessive royalties if they are constrained by ex ante obligations—such as disclosing

[29] Suppose the implementer's strategy is to "redesign only if the patent is valid." Then, the implementer would be exposed to holdup if the patent is actually valid. The agreement payoff is MX as before. The disagreement payoff is $\theta(M - V)X + (1 - \theta)MX - (1 - \theta)\theta[holdup]$, because a patent thought to be invalid can actually be found valid and infringed in Court. Hence, the negotiated royalty would exceed the desired benchmark in this case as well.

[30] Early disclosure leads to superior outcomes only in the following two cases: (a) when the patented feature is "nothing special" ($V = 0$), meaning that there is an equally-effective alternative technology, the downstream firm would switch to the non-infringing alternative without cost; (b) when the patent is "ironclad" ($\theta = 1$), meaning that it surely will be proven valid and infringed if the parties proceeded to litigation, they would agree on a predesign license at the benchmark level, BV.

essential patents, declaring FRAND commitments, or posting maximum royalty rates they would charge on their SEPs—because the implementer still has the option to switch away to an alternative before it is locked into a specific technology. Patent holders are induced to demand reasonable licensing terms, or else standard developers could change the content and scope of the standard or choose another technology that is covered by fewer or no patents.

Unlike non-SEPs, the ex post lock-in effect of standardization also raises concern about "over-disclosure." That is, patent holders can declare patents that are not actually essential as SEPs, either intentionally or inadvertently, which can make their patent portfolio appear more comprehensive and valuable and allow them to demand supra-competitive royalties on what could have been avoided by standard implementers. [31] Patent holders are able to over-assert patents because standards organizations typically do not evaluate the essentiality of declared patents nor oblige SSO members to search their patent portfolios. In fact, Fairfield Resources International (2010, p. 1-2) finds that among 210 patent families declared essential to either LTE or SAE standards, only 50% of them have at least one patent judged "essential" or "probably essential." Since the process of challenging the patent holder may be lengthy and costly, the downstream firm could be forced to accept licensing terms even if the firm could assess the essentiality and validity of the SEPs before making standard-specific investments.

[31] Note that some standards organizations define a patent to be essential even if it is necessary to implement an optional portion or an optional mode of the standard. IEEE states that "*Essential Patent Claim* shall mean any Patent Claim the practice of which was necessary to implement either a mandatory or optional portion of a normative clause of the IEEE Standard when, at the time of the IEEE Standard's approval, there was no commercially and technically feasible non-infringing alternative implementation method for such mandatory or optional portion of the normative clause" (Clause 6.1 definition).

III.B. FRAND Commitment

To reduce the bargaining power of SEP owners from standardization, SSOs enforce their members to make a voluntary commitment to license their patents on fair, reasonable, and non-discriminatory (FRAND) terms. ETSI specifies in its IPR Policy that:

> When an ESSENTIAL IPR relating to a particular STANDARD or TECHNICAL SPECIFICATION is brought to the attention of ETSI, the Director-General of ETSI shall immediately request the owner to give within three months an irrevocable undertaking in writing that it is prepared to grant irrevocable licenses on fair, reasonable and non-discriminatory ("FRAND") terms and conditions under such IPR. (Clause 6.1)[32]

The Policy obliges SEP holders to surrender some of their exclusionary rights in exchange for their patents' inclusion into a standard.[33] Patent owners have the incentive to participate in standard-setting despite the constraint on their market power because standardization exposes SEPs to a large pool of potential licensors, and systematic coordination between patent holders to charge low royalties could lead to higher individual payoffs under the Cournot complements theory. By committing to license on non-discriminatory terms, SEP owners are also prevented from forming a "coalition to create and exercise market power" and imposing different licensing terms on non-SSO firms and new entrants (Carlton and Shampine, 2013, p. 543). The FRAND commitment hence facilitates fair competition, encourages safe adoption of standards, and allows more efficient negotiation outcomes.

---

[32] From ETSI IPR Policy. http://www.etsi.org/images/files/IPR/etsi-ipr-policy.pdf

[33] Although SSOs have limited enforcement powers, SEP holders failing to honor FRAND commitments could constitute an anti-competitive behavior. A noteworthy case is *Qualcomm v. Broadcom*, in which Qualcomm was accused of obtaining monopoly power in certain markets by making a false promise to license its essential technology on FRAND terms. The Federal Circuit ruled in favor of Broadcom, denying Qualcomm's patent rights for all products that implement the relevant standard.

In the context of standardization, scholars argue that permanent injunctions should not be issued on SEPs because monetary damages equal to reasonable royalties suffice to compensate for the injury from patent infringement (Sidak, 2015b, p. 205). The European Commission (EC) held in *Samsung* and *Motorola* that it is anti-competitive to seek injunctions on SEPs if the licensee has shown its "willingness" to take a license on FRAND terms.[34] The decision relies on the four-factor test following *eBay*, which requires to show that the patent owner would suffer from "irreparable" harm without an injunctive relief upon infringement. As a FRAND-encumbered SEP holder has given up "its right to exclude from the use of the SEPs any implementer willing to pay FRAND compensation," there may be a fundamental difficulty in establishing irreparable injury regarding SEPs (Sidak, 2015b, p. 206).

Critics yet argue that limiting the SEP holder's right to exclude and obtain injunctions could allow downstream firms to engage in "reverse holdup," or "holdout," by deliberately rejecting FRAND offers and free-riding on the invention, as the court-driven damage award is unlikely to exceed the FRAND royalty.[35] That is, standard implementers could pursue a legal remedy and continue to produce the infringing product hoping that the SEP holder would give up its efforts and settle out of court for a lower royalty, especially if the SEP at issue is weak or litigation costs are high. When there are multiple downstream firms, the SEP holder's settlement with one infringer could negatively affect the negotiation with other infringers, potentially incurring substantial royalty losses on the SEP holder in aggregate.

[34] The definition of a willing licensee depends on the facts of the case. The EC notes that the *Samsung* and *Motorola* decisions "provide a "safe harbor" for willing licensees who want to avoid the risk of being the subject of an injunction on the basis of SEPs, i.e. companies which, in case of dispute, are willing to have FRAND terms determined by a court or arbitrators (if agreed between the parties) and to be bound by such a determination." (The EC Memo, 2014, found at http://europa.eu/rapid/press-release_MEMO-14-322_en.htm)

[35] Although I use the two terms interchangeably here, scholars note that "while reverse holdup refers to the situation when licensees use their leverage to obtain rates and terms below FRAND, holdout refers to licensees either refusing to take a FRAND license or delaying doing so" (Wright et al., 2016, p. 12).

Denying patent owners of the right to seek an injunction thus promotes litigation activities, “rather than [facilitating] voluntary licensing agreements between the parties,” and discourages SEP owners from making innovative investments and participating in standard-setting (Sidak, 2015b, p. 207). Recent cases such as *Rambus* and *Broadcom* have shown the difficulty in establishing an antitrust action for FRAND-encumbered SEPs. As standards organizations do not provide clear guidance on patent disclosure and the reasonable royalty range, there is room for interpretation for patent owners and standard implementers to engage in strategic behaviors.

III.C. Extension: Lemley-Shapiro Holdup Model With No Redesign

In this section, I extend the Lemley-Shapiro holdup model such that it can be understood in relation to SEPs and the standard-setting process. I make two modifications: (a) an initial technology decision stage is added, where the downstream firm chooses among multiple patented technologies that provide the same function; and (b) the redesign option is no longer available when negotiation breaks down. In reality, manufacturers cannot invent around standardized technologies because they allow inter-operation and connection with other products and platforms. Therefore, without sufficient royalty-constraining measures, the injunction threat can empower patent holders to extract royalties based on the entire value of a product, and an implementer anticipating such holdup can be discouraged from adopting a technology that is covered by a strong patent even if it is superior to alternative options.

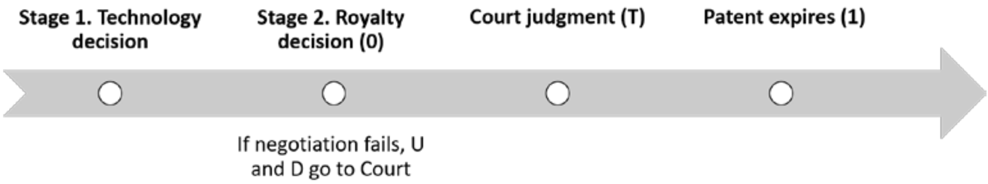

Figure 4. Timeline of the modified Lemley-Shapiro holdup model. In the first stage, the downstream firm chooses between patented technologies, and in the second stage, the parties negotiate a royalty.

As illustrated in Figure 4, I examine a two-stage game: in the first stage, the implementer compares and decides between alternative technologies, and in the second stage, the contracting parties negotiate a royalty for the chosen technology. For simplicity, suppose there are two alternative patented technologies. Let $V_i\ \forall i = 1{,}2$ denote the additional value generated by incorporating each technology into the product compared to a non-infringing or unpatented alternative. Each technology is covered by an independent patent with strength $\theta_i\ \forall i = 1{,}2$. As in Lemley and Shapiro (2007a), normalize patent life to 1, and suppose it takes $0 \leq T \leq 1$ for the Court to reach a decision on patent validity and infringement. Let the downstream firm's per-unit margin without the patented feature be defined as $\mathcal{M}$.[36] Note that implementing Technology $i = 1{,}2$ increases the margin to $\mathcal{M} + V_i$.

In Section III.C.a, I examine the standard case of ex post negotiation with technological lock-in. In Section III.C.b, I show how patent holders' ex ante royalty commitments prior to technology decision could positively impact the negotiation outcome.

III.C.a. Ex Post Negotiation

The game is solved backwards. I first predict the disagreement payoffs of the two parties in the second stage. Suppose Technology i is adopted. The implementer

[36] This is different from Lemley and Shapiro's (2007a) M, which is the per-unit margin when the patented technology is incorporated into the final product.

continues to sell its product while litigation is pending, so it earns $(\mathcal{M} + V_i)$ per unit during $[0, T]$. If the implementer wins the litigation, it can earn $(\mathcal{M} + V_i)$ for the remaining term of the patent. If the patent is found valid and infringed, however, the Court would require the implementer to pay damages S incurred during $[0, T]$ and grant the patent holder injunctive relief effective for $[T, 1]$. Suppose the parties were to negotiate again at T before the judgment. If the patent holder is granted an injunction, the implementer has no option other than exiting the market, which would result in both firms earning zero payoff during $[T, 1]$. The agreement payoff is the implementer's entire profit margin, $(\mathcal{M} + V_i)$. Then, assuming Nash bargaining, the implementer is willing to pay $B(\mathcal{M} + V_i)$ to the patent holder during $[T, 1]$ to avoid market withdrawal. Combining the expected outcomes, the negotiated royalty in the second stage is $T\theta_i S + (1 - T)B\theta_i(\mathcal{M} + V_i)$.

As for damages, the expected royalties should not exceed the value of the patented feature $\theta_i S \leq V_i$. Typically, compensation for patent infringement is determined by the royalty the patent holder would have normally received based on the value attributable to the patented technology. Hence, I assume $S = BV_i$.[37] That is, the damage payment reflects the Nash bargaining solution when the patent is known to be surely valid and infringed. Then, the negotiated royalty in the second stage is $\theta_i BV_i + (1 - T)\theta_i B\mathcal{M}$, and the implementer's payoff is $\mathcal{M} + V_i - (\theta_i BV_i + (1 - T)\theta_i B\mathcal{M})$.

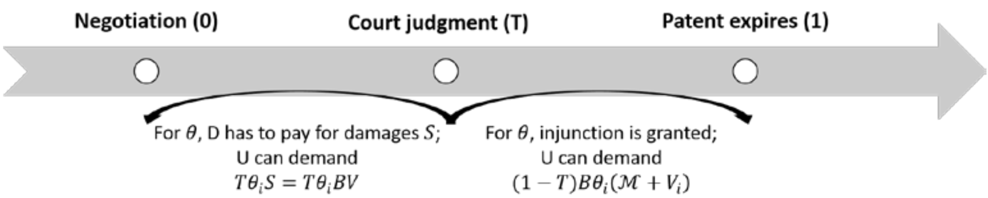

Figure 5. Timeline of the game when redesign is not possible. The figure shows how the patent holder of a chosen technology is able to extract an excessive royalty in the shadow of an injunction.

[37] This "reasonable royalty" level is also assumed in Lemley and Shapiro (2007a).

If the benchmark royalty is $B\theta_i V_i$, the percentage royalty overcharge is given by $(1-T)\frac{\mathcal{M}}{V_i}$.[38] This implies that the holdup effect is amplified when the Court is able to make a timely decision or when the patented feature is a minor part of a large, complex invention, which is consistent with Lemley and Shapiro (2007a). As the implementer is at the risk of losing the *entire* value of the product when faced with an injunction, it is willing to settle for a level that exceeds the expected intrinsic value of the patented feature. Note that the percentage overcharge is greater than that in the "litigate without redesign" case if $\frac{1-L-T}{C} > \frac{V}{\mathcal{M}}$. Compared to a non-SEP that can be easily designed around in a relatively short period of time, an essential patent can lead to substantial over-compensation of its holder, especially if it reads on a minor component of a complex product.

Such holdup risk could encourage the implementer to adopt a strictly inferior technology. In the first stage, the downstream firm makes a technology decision that maximizes its ex post payoff. The firm prefers to adopt Technology 1 if

$$\Leftrightarrow \mathcal{M} + V_1 - (\theta_1 B V_1 + (1-T)\theta_1 B \mathcal{M}) > \mathcal{M} + V_2 - (\theta_2 B V_2 + (1-T)\theta_2 B \mathcal{M})$$

$$\Leftrightarrow V_1 - V_2 > (1-T)B\mathcal{M}(\theta_1 - \theta_2) + B(\theta_1 V_1 - \theta_2 V_2).$$

Suppose $V_1 > V_2$, i.e. Technology 1 is superior to Technology 2. The above inequality would always hold if $\theta_1 < \theta_2$ and $\frac{V_1}{V_2} < \frac{\theta_2}{\theta_1}$. That is, the downstream firm prefers to adopt the superior technology when it is covered by a relatively weak patent and its benchmark royalty is smaller than the alternative. In other cases, however, the implementer has an incentive to choose the inferior option. Generally speaking, the firm is more likely to adopt Technology 2 when $(V_1 - V_2)$ and T are relatively small, and $(\theta_1 - \theta_2)$, B, and $\mathcal{M}$ are relatively large. The implementer

[38] To my knowledge, Carlson et al. (2013) is the only study that has examined the Lemley-Shapiro model such that redesign is impossible. The authors' analysis of the holdup effect is consistent with ours. They note that "patent hold-up is larger the smaller is the contribution of the patented innovation to the overall value that is created by the downstream product…[and] patent hold-up is larger the shorter the duration of litigation" (p. 24).

prefers to use a technology that is associated with a lower chance of obtaining an injunction, especially when a large profit margin is at stake.

It is important to check which technology is more desirable from a social welfare perspective. Recall that $\mathcal{M} \equiv P - c$ for the product without the patented feature. For simplicity, suppose demand is linear, $X = A - P$, and normalize the downstream production cost to zero. Then, $P = \mathcal{M}$ and $X = A - \mathcal{M}$. Suppose Technology i is selected. As the consumer's willingness to pay increases by V_i, the price of the product becomes $\mathcal{M} + V_i$. Then, the owner of the patent covering Technology i earns $(\theta_i BV_i + (1-T)\theta_i B\mathcal{M})(A - \mathcal{M})$, the other patent holder earns zero payoff, and the implementer earns $[\mathcal{M} + V_i - (\theta_i BV_i + (1-T)\theta_i B\mathcal{M})](A - \mathcal{M})$. The aggregate profit of the agents is thus $(\mathcal{M} + V_i)(A - \mathcal{M})$. Consumer surplus is given by $\frac{(A-\mathcal{M})^2}{2}$. The social welfare is the sum of consumer surplus and the aggregate profits of the firms, so $SW_i = (\mathcal{M} + V_i)(A - \mathcal{M}) + \frac{(A-\mathcal{M})^2}{2}$. The greater the inherent value of a technology, the greater the social surplus generated, as illustrated in Figure 6. It is thus socially desirable for the downstream firm to adopt Technology 1 even if the firm is able to capture a smaller share of the margin.

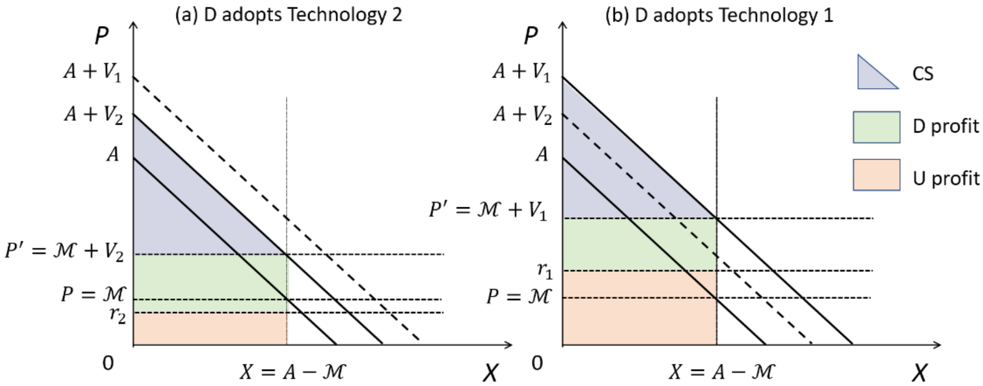

Figure 6. Graph illustrating the division of surplus. Consumer surplus is represented by the area below the demand curve and above the equilibrium price (blue triangle); upstream firm profit is represented by the area below the negotiated royalty level (orange rectangle); downstream firm profit is represented by the area in-between

(green rectangle). Total surplus is larger in Panel (b) although the downstream firm earns greater profit in Panel (a).

The following numerical example shows how the implementer's decision could bring about a socially suboptimal outcome. Suppose $B = 0.5, \mathcal{M} = 30, V_1 = 14, V_2 = 10, \theta_1 = 0.6, \theta_2 = 0.4, A = 50$, and $T = \frac{1}{3}$. If demand is linear, $X = 20$. Notice that Technology 1 is superior to Technology 2, but $\theta_1 < \theta_2$ and $\theta_1 V_1 > \theta_2 V_2$. Then, if Technology 1 is adopted, the negotiated per unit royalty is 10.2, and the implementer's net payoff is 676. If Technology 2 is selected, the negotiated royalty is 6 with the implementer's payoff of 680. This implies that the downstream firm can earn an additional payment of 4 by adopting Technology 2. Yet, the percentage overcharge associated with Technology 2 is $\frac{7}{5}$ times greater than that of Technology 1, and adopting Technology 2 results in $SW_2 = 1000$, which is $\frac{2}{25}$ times smaller than $SW_1 = 1080$. This implies that the loss on society is 20 times larger than the implementer's relative gains. This example reveals the need to constrain the patent holder's ability to charge a high royalty and resolve the conflict between private and public interests.

III.C.b. Negotiation with an Ex Ante Commitment

This section examines how making an ex ante commitment on royalty rates prior to technology decision could positively influence negotiation outcome. Suppose the patent holders are required to disclose the maximum royalty rate they could impose on their patents.[39] Let r_1 and r_2 denote the respective royalty caps. Since the implementer now compares the technology options along with their expected royalty, both patent holders have the incentive to commit to a royalty rate lower than what it

[39] Since 2007, VMEbus International Trade Association ("VITA") requires its members to post the maximum royalty rate and encourages them to provide the most restrictive draft license agreement on their potential essential patents (New VITA Patent Policy, 2007, p. 5).

would have been in the absence of any ex ante disclosure. In particular, they would not demand a royalty higher than the value of the patented feature, $r_i \leq V_i$, because otherwise the implementer could opt for an unpatented or non-infringing alternative and just earn $\mathcal{M}$. Notice that if the patent owners engage in Bertrand competition, they would compete to get their patent included in the product by declaring r_1 and r_2 at the lowest level possible.[40] This could help the implementer to make the technology decision with less risk of holdup in the second stage.

Figure 7. Timeline of the game with an ex ante royalty commitment. Patent holders engage in Bertrand-like pricing competition to decide on a royalty rate.

The game is solved backwards. In the second stage, the patent holder of the chosen technology would simply charge a royalty rate equal to the upper bound, r_i. Suppose the downstream firm is willing to accept this proposal rather than litigate.[41] Then, the firm's expected payoff from adopting Technology i is $\mathcal{M} + V_i - r_i$. For Technology i to be selected in the first stage, the price paid by the implementer

[40] This approach is consistent with Swanson and Baumol (2005). They suggest holding an auction between patent holders to submit licensing term offers. The winners of the auction would "comprise the final standard and the auction terms would define the maximum royalty rate allowable ex post" (Geradin et al., 2008, 148). Swanson and Baumol (2005) use a simple example to explain their model: there are two technologies, A and B, and adopting Technology A results in downstream production costs $MC_A = 5$ while adopting Technology B results in $MC_B = 6$. The authors show that Technology A should win the auction at a license fee of 1, which is equivalent to an asymmetric cost Bertrand solution.

[41] Suppose the implementer's strategy is to refuse to pay the royalty offered in the first stage. If the patent holders anticipate this behavior, the outcome would be equivalent to the case analyzed in Section III.C.a. The implementer would have to pay for damages and face an injunction when it loses the infringement litigation, so the patent holders would set the royalty cap at $B\theta_i V_i + B(1-T)\theta_i \mathcal{M}$. The implementer would prefer Technology 1 only if $V_1 - V_2 > (1-T)B\mathcal{M}(\theta_1 - \theta_2) + B(\theta_1 V_1 - \theta_2 V_2)$. Since $V_1 - (V_2 - r_2)$ is likely to be smaller than this level, the implementer should be willing to accept the royalty offer in the second stage.

should be no greater than its relative gains, $r_i \leq V_i - (V_j - r_j)$ where $i \neq j$. If the parties split the joint surplus under Nash bargaining, the highest royalty the patent holder is able to charge is $r_i = B\left(V_i - (V_j - r_j)\right)$. If the patent holders engage in Bertrand competition, one of the firms would set a royalty equal to 0 as they both wish to undercut the rival's bid to win the game and capture the entire market. Suppose $V_1 > V_2$. Then, the maximum royalty rates declared by the patent holders in equilibrium are $r_2^* = 0$ and $r_1^* = B(V_1 - V_2) - \epsilon$. That is, the royalty negotiated is equal to its relative merit discounted by the bargaining parameter. Notice that the implementer's expected payoff from adopting Technology 1 is strictly greater than that of Technology 2 when $B < 1$. This implies that under the price cap scheme, the implementer always prefers the superior technology, which is the socially desired outcome in the first stage.

One limitation of the price cap policy is that since the royalty upper bound is determined independently of patent strength, there can be a wide disparity between the declared rate and the Lemley-Shapiro benchmark. Specifically, if $\frac{V_1}{V_2} > \frac{1}{1-\theta_1}$, the patent holder is able to demand a supra-competitive royalty above the benchmark level, $B\theta_1 V_1$. That is, if one technology is substantially superior to the other, or if the patent covering it is considerably weak, placing a cap in advance could be insufficient to reverse the negative effects of holdup. Yet, the implementer could still find the policy to be a meaningful regulatory device if the capped rate is lower than $\theta_1 B V_1 + (1 - T)\theta_1 B \mathcal{M}$, which is what the implementer would have faced in the absence of any ex ante disclosure requirement.

In practice, it is more problematic when the royalty cap on Technology 1 falls below the benchmark level, i.e. $\frac{V_1}{V_2} < \frac{1}{1-\theta_1}$, because the patent owners would be under-compensated for their economic contribution. In the above numerical example, the negotiated royalty with a price cap is 2, which is less than half of the Lemley-Shapiro benchmark of 4.2. Anticipating such limited return from licensing, patent owners can be reluctant to share their knowledge or contribute to technology standards, potentially chilling future innovation and patenting activities. This could explain why the price cap policy has not been popular among standards organizations. There are concerns that a restrictive disclosure policy could lead to not only below-optimal royalty rates but also declined membership, low-quality standards, and longer standards-developing activity.[42] These predictions run against the very purpose of standardization to encourage innovation and competition.

While the price cap policy is rarely enforced by standards organizations, most SSOs require their members to license on FRAND terms. The meaning of FRAND is uncertain and there can be a wide range of fair and reasonable licensing terms, but for simplicity, suppose the implementer expects to pay the Lemley-Shapiro benchmark rate for each technology.[43] Then, in the first stage, the implementer would choose Technology 1, i.e. the socially desired option, if $\frac{V_1}{V_2} > \frac{1-B\theta_2}{1-B\theta_1}$.[44] This is the ideal outcome because the downstream firm is able to incorporate the superior technology into its product and pay the benchmark royalty to the patent holder. Even if the above condition fails, which is more likely when $V_1 - V_2$ is small or $\theta_1 - \theta_2$ is large, it is possible that the implementer chooses Technology 1 in the first stage in the context of SEPs because of the vague and flexible nature of the FRAND terms. That is, as SEP holders are unable to obtain an injunction against a *willing* licensee, the implementer might be able to negotiate a royalty smaller than $\theta_i B V_i$ within the FRAND range, and anticipating such possibility of holdout, the

[42] Some studies claim that a restrictive ex ante policy does not necessarily lead to negative consequences. Contreras (2013) finds no evidence that VITA's mandatory disclosure policy hindered standard-setting processes, resulted in standards of lower quality, or depressed patent royalty rates; he rather finds increased VITA membership and an overall positive perception of the policy change by the standard members. The author also examines IEEE's optional policy to disclose the most restrictive licensing terms and finds no evidence that the policy change had an adverse impact on standards activities. Yet, more data is needed to determine the actual effects of the royalty cap policy on SSOs.

[43] This is equivalent to patent holders setting $r_i = B\theta_i V_i$ under the royalty cap scheme.

[44] The downstream firm's payoff from adopting Technology 1 is greater than that of Technology 2 if $\mathcal{M} + V_1 - B\theta_1 V_1 > \mathcal{M} + V_2 - B\theta_2 V_2$.

implementer's strategy in the first stage could be to choose the technology that generates greater economic value.

The two ex ante policies have their own advantage: the price cap regulation can guarantee the selection of the superior technology, while the FRAND commitment can guarantee a reasonable rate of compensation to the patent owner. From the implementer's standpoint, the FRAND obligation is preferable because it can eliminate the risk of holdup. From the patent holders' standpoint, the price cap scheme may be undesirable because it can drive the royalty payment below the reasonable level. From the social planner's point of view, the royalty cap policy could be more efficient as it induces the implementer to always make the optimal technology decision. Yet, as it can be difficult for both parties to predict the value and strength of a patent early in the standard-setting process, the price cap policy could be too restrictive and vulnerable to manipulation in the real world. Hence, the FRAND regulation might be the more practical and reasonable method to impose a constraint on the negotiating power of patent holders.

III.C.c. Limitations of the Modified Holdup Model

The new model relies on several simplifying assumptions. In reality, the standard-developing process is not as straightforward as the two-stage game between one downstream and two upstream firms. The following limitations should be addressed in future studies.

First, the standard-setting procedure consists of multiple steps of preparation, negotiation, and decision-making. As agents interact with each other on a regular and repeated basis, the royalty overcharge might not be as high as predicted in the holdup model, whereas with the ex ante disclosure policy, the patent holders might be able to collude and set royalty caps higher than the one-shot Bertrand equilibrium outcome. Future research should consider a model with repeated and sequential negotiation process to reflect the long-term relationship between patent holders and standard developers.

Second, as various interest groups—such as patent owners, consumers, implementers, and vertically integrated firms—participate and contribute to the standard-setting process, the decision of technology adoption and royalty negotiation should take into account the collective interests and payoffs of stakeholders, rather than simply comparing the implementer's expected profit. Also, as influential members might be able to force their preferences over those of others or pull the negotiation in their favor, it might be appropriate to assign different weights to agents or specify different B's between agent pairs.

Third, more work is needed to understand how enforcing FRAND would affect the behavior and choices of the agents within the Lemley-Shapiro framework. Future research could specify a FRAND royalty range that balances the implementer's willingness to pay with the SEP holder's willingness to accept and discuss how a royalty rate should be selected within the range. Future studies could also examine how the negotiation outcome might change when the implementer is an *unwilling* licensee.

III.D. Empirical Evidence Inconsistent with the Theory

In the mobile phone business, there is an increasing number of antitrust claims and patent litigations being filed (referred to as "smartphone patent wars"). It is said that there are more than 250,000 smartphone-related U.S. patents, and that dozens of standards and thousands of patents read on a mobile device (RPX Corporation, 2011).[45] Armstrong et al. (2014) claim that on a hypothetical $400 smartphone, royalties can add up to over $120 in absence of payments and rebates "made in the

[45] Galetovic and Haber (2017) note that "between 1994 and 2013, the number of SEP holders increased from 2 to 128;" in theory, "patent holdup and its related mechanisms of royalty stacking and market power conferred by standards should have choked off the incentives to invest in R&D" (p. 8, footnote 18).

form of cross-licenses and patent exhaustion arising from licensed sales by component suppliers" (p. 2). If patent holdup and royalty stacking pose a serious threat to the public interest, potentially requiring antitrust attention, one expects to find inefficient market outcomes in the downstream market. The weaker bargaining position of downstream manufacturers should discourage their incentive to innovate (such as to reinvest in R&D and to enter the market) and should have negative consequences on consumer choice and final prices.

Yet, Galetovic and Gupta (2016) find that while the quality of handheld devices (phones and tablets with telecommunication technologies) has improved over time, the average selling price has decreased at a rate of about 10-20 percent annually, and the number of phone manufacturers has generally increased.[46] Galetovic and Haber (2017, p. 8) find that rates of innovation in phone equipment (ranging from fax machines to cell phones) has been much faster than the economy-wide average since 1997 (p. 8).[47] They also note that contrary to the royalty stacking theory, "the cumulative royalty yield from the twenty-one largest patent licensors in the mobile phone value chain was only 3.3 percent of a mobile phone's average sales price… since at least far back as 2007" (p. 8-9). Although the patent holdup and royalty stacking theory predicts to find higher prices, reduced output, fewer entry, and slower innovation, empirical studies find the opposite result in the smartphone market.

Given the conflicting empirical results, critics argue that patent holdup and royalty stacking are merely theoretical concerns and that the underlying market structure and economic mechanisms could prevent agents from reaching inefficient outcomes. In high-tech industries, numerous patent holders and downstream firms

[46] Yet, note that only a handful of manufacturers is actually profiting in the mobile phone market. In the second quarter of 2016, the operating margins of Apple and Samsung were 38% and 17%, respectively, but other companies such as Microsoft, BlackBerry, and LG were generating operating loss on their smartphone sales (Fortune, 2016).

[47] Rates of innovation is measured by "examining relative rates of change of quality-adjusted prices;" the Bureau of Labor Statistics' "product-by-product, quality-adjusted price data" is publicly available for download (Galetovic and Haber 2017, p. 7).

exist, and they interact in a repeated manner, often times involving multiple products and in different positions in the supply chain. In such setting, firms would have lower incentives to act opportunistically and noncooperatively because having a bad reputation could trigger future punishments. They are also likely to form patent pools and enter into cross-licensing agreements to avoid patent disputes and mitigate the problems arising from lack of cooperation.[48] Hence, a patent holder's injunctive power may well be exercised "for a legitimate purpose, rather than as a tool to extract opportunistic licensing terms," and the negotiated royalty may well be in the FRAND range (Sidak, 2015, p. 233-234).

The inconsistency between reality and theory could also be due to recent changes in the patent system following the work of Lemley and Shapiro (2007a). As scholars have expressed concerns about patent holders achieving disproportionate bargaining power, courts have adopted a more cautionary approach when evaluating patent infringement claims, providing remedies (such as damages and injunctions), or fixing a reasonable royalty range for essential patents. Similarly, standards organizations have come to enforce a stricter set of requirements, such as timely disclosure of SEPs and FRAND obligations, to prevent patent owners from abusing their patent rights. Since various factors are involved in technology and royalty decisions, more data are necessary to test and analyze the existence and severity of the patent holdup and royalty stacking phenomena in high-tech markets.

[48] A patent pool consolidates patent rights into a single package and operates like one upstream firm, selecting a fixed rate that is high enough for major patent owners to participate and low enough to be widely adopted (Geradin et al., 2008, p. 146-147). It is a balanced profit sharing scheme that reflects the competitive process of bilateral bargaining between buyers and sellers. Unlike SSOs, patent pools only include SEPs that are verified as essential by independent experts, eliminating the risk of excessive royalties from over-disclosure. Yet, forming a patent pool could incur substantial costs (such as for search, evaluation, and negotiation), especially if the patents differ greatly in their strength and scope. Also, a patent owner that does not operate in the downstream market is less likely to join such arrangement "unless it believes that its failure to join the pool will undermine the formation of the pool and thus seriously hinder sales of the product in question" (Lemley and Shapiro, 2007a, p. 2014).

IV. Conclusion

With the increased importance of intangible assets, there has been extensive debate on whether the current patent system is adequate to protect intellectual property and promote innovation and growth in complex industries. Academics and policy makers have raised concerns that the exclusionary nature of patents, combined with the widespread adoption of technical standards, could lead to problems such as patent holdup and royalty stacking. This article highlights the underlying economic framework of the two problems and examines the implications in relation to standard-essential patents. It makes an attempt to extend the Lemley-Shapiro holdup model to the context of SEPs by making two modifications: (a) the downstream firm decides among multiple alternative technologies, and (b) redesign is impossible once a technology is adopted. The modified model shows that patent holdup can be amplified when design-around is not an option and that the downstream firm could prefer to use an inferior technology because of the probabilistic nature of patents. Declaring ex ante commitments on royalty rates can mitigate such negative consequences. The price cap policy can guarantee that the patent holder makes a superior choice, and the FRAND obligation can eliminate the risk of holdup and guarantee a reasonable royalty rate. This implies that if standards organizations provide clearer guidance on patent disclosure and FRAND terms, they can impose a substantial limitation on the negotiating power of SEP holders and lead to a more socially efficient outcome. As there is limited data on patent licensing terms, especially for essential patents, further research is necessary to understand the significance of the patent holdup and royalty stacking phenomena in the real world.

References

Allison, J. R., Lemley, M. A., & Walker, J. (2011). Patent quality and settlement among repeat patent litigants. *Georgetown Law Journal*, 99, 677–712.

Armstrong, A. K., Mueller, J. J., & Syrett, T. (2014). The Smartphone Royalty Stack: Surveying Royalty Demands for the Components Within Modern Smartphones (Working Paper, May 29, 2014). Retrieved from *SSRN Electronic Journal*. doi:10.2139/ssrn.2443848

Carlson, J. A., Dafny, L. S., Freeborn, B. A., Ippolito, P. M., & Wendling, B. W. (2013). Economics at the FTC: Physician Acquisitions, Standard Essential Patents, and Accuracy of Credit Reporting. *Review of Industrial Organization*, 43(4), 303-326. doi:10.1007/s11151-013-9411-y

Carlton, D. W., & Shampine A. L. (2013). An Economic Interpretation of FRAND. *Journal of Competition Law and Economics*, 9 (3): 531-552.

Contreras, J. L. (2013). Technical Standards and Ex Ante Disclosure: Results and Analysis of an Empirical Study. *Jurimetrics*, 53 (1): 163-211.

Cournot, A. (1838). *Researches into the Mathematical Principles of the Theory of Wealth*. (N. T. Bacon., Trans.). London/ New York: Macmillan Co.

Denicolo, V., Geradin, D., Layne-Farrar, A., & Padilla., J. (2008). Revisiting Injunctive Relief: Interpreting eBay in High-Tech Industries with Non-Practicing Patent Holders. *Journal of Competition Law and Economics*, 4: 571-608.

Elhauge, E. R. (2008). Do Patent Holdup and Royalty Stacking Lead to Systematically Excessive Royalties? *Journal of Competition Law and Economics*, 4(3), 535–570. doi:10.2139/ssrn.1139133

ETSI Rules of Procedure, 5 April 2017. Annex 6: ETSI Intellectual Property Policy. http://www.etsi.org/images/files/IPR/etsi-ipr-policy.pdf

ETSI What are standards? http://www.etsi.org/standards/what-are-standards

The EC Memo 14/322, 29 April 2014. "Antitrust decisions on standard essential patents (SEPs) - Motorola Mobility and Samsung Electronics - Frequently asked questions." http://europa.eu/rapid/press-release_MEMO-14-322_en.htm

Fairfield Resources International. (2010). Review of Patents Declared as Essential to LTE and SAE (4G Wireless Standards) Through June 30, 2009. Darien, CT: Fairfield Resources International. Retrieved from http://www.frlicense.com/LTE%20Final%20Report.pdf

Farrell, J., Hayes, J., Shapiro, C., Sullivan, T. (2007). Standard setting, patents, and hold-up. *Antitrust Law Journal*, 74(3), 603-670.

Farrell, J., & Shapiro, C. (2008). How strong are weak patents? *American Economic Review*, 98(4), 1347–1369.

Galetovic, A., & Gupta, K. (2016) Royalty Stacking and Standard Essential Patents: Theory and Evidence from the World Mobile Wireless Industry (Working paper, Jun. 2016).

Galetovic, A., Haber, S., & Levine, R. (2015). An Empirical Examination of Patent Holdup. *Journal of Competition Law & Economics*, 11(3), 549–578. doi:10.1093/joclec/nhv024

Galetovic, A., & Haber, S. (2017). The Fallacies of Patent Holdup Theory. *Journal of Competition Law & Economics*, 13(1), 1-44.

Geradin, D., Layne-Farrar, A., & Padilla, J. A. (2008). The Complements Problem within Standard Setting; Assessing the Evidence on Royalty Stacking. *BUJ Sci. and Tech. L.*, 14.

Golden, J. M. (2007). Commentary: Patent Trolls and Patent Remedies. *Texas Law Review*, 85:2111.

IEEE-SA Standards Board Bylaws. December 2016. http://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf

Karbowski, A., & Prokop, J. (2015). Patent Hold-up and Royalty Stacking: The Case of Multiple Downstream Firms. *Procedia Economics and Finance*, 24, 306-312. doi:10.1016/s2212-5671(15)00666-8

Kesan, J.P. & Ball, G. G. (2006). How Are Patent Cases Resolved? An Empirical Examination of the Adjudication and Settlement of Patent Disputes. *Washington University Law Review*, 84, 237-312.

Layne-Farrar, A. (2014). Patent Holdup and Royalty Stacking: Theory and Evidence, Where do I Stand after 15 Years of History? Submitted for Financial and Enterprise Affairs, OECD Competition Committee. Paris OECD.

Lemley, M., & Shapiro, C. (2007a). Patent Holdup and Royalty Stacking. *Texas Law Review,* 85: 1991-2049.

Lemley, M., & Shapiro, C. (2007b). Reply: Patent Holdup and Royalty Stacking. *Texas Law Review*, 85: 2163-2173.

Llobet, G., & Padilla, J. (2016). The Optimal Scope of the Royalty Base in Patent Licensing. *The Journal of Law and Economics*, 59(1), 45-73. doi:10.1086/686306

Morton, S. F., & Shapiro, C. (2016). Patent Assertions: Are I Any Closer to Aligning Reward to Contribution? *Innovation Policy and the Economy: Volume 15*. Chicago: University of Chicago Press, 89-133.

Posner, R.A. (2005). Intellectual Property: The Law and Economics Approach. *Journal of Economic Perspectives*, 19(2), 57-73.

Rambus Inc. v. FTC, 522 F.3d 456, 459 (D.C. Cir. 2008).

RPX Corporation, Registration Statement (Form S-1), 2 September, 2011. https://www.sec.gov/Archives/edgar/data/1509432/000119312511240287/ds1.htm

Schmalensee, R. (2009) Standard-Setting, Innovation Specialists and Competition Policy. 57 *Journal of Industrial Economics* 526.

Shapiro, C. (2000). Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting. *Innovation Policy and the Economy*, 1, 119-150. doi:10.1086/ipe.1.25056143

Shapiro, C. (2010). Injunctions, Hold-Up, and Patent Royalties. *American Law and Economics Review*, 12(2), 280–313.

Sidak, G. J. (2007). Holdup, Royalty Stacking, and the Presumption of Injunctive Relief for Patent Infringement: A Reply to Lemley and Shapiro. *Minnesota Law Review*, 92, 714-748.

Sidak G. J. (2015a). THE MEANING OF FRAND, PART I: ROYALTIES. *Journal of Competition Law & Economics*, 9(4), 931–1055 doi:10.1093/joclec/nht040

Sidak G. J. (2015b). THE MEANING OF FRAND, PART II: INJUNCTIONS. *Journal of Competition Law & Economics*, 11(1): 201-269. doi: 10.1093/joclec/nhv005

Supreme Court of the U.S. Syllabus. EBAY INC. et al., v. MERCEXCHANGE, L.L.C. No. 05–130. https://www.supremecourt.gov/opinions/05pdf/05-130.pdf

Swanson, D. G., & Baumol, W.J. (2005). Reasonable and nondiscriminatory (RAND) royalties, standards selection, and control of market power. *Antitrust Law Journal*, 73(1), 1-58.

THE INTERNATIONAL PATENT SYSTEM IN 2006 PCT YEARLY REVIEW. http://www.wipo.int/export/sites/www/pct/en/activity/pct_2006.pdf

VITA, 2007. New VITA Patent Policy. http://www.vita.com/resources/Documents/Policies/VITA%20Patent%20Policy%20Presentation.pdf

WIPO,15 March, 2017. "Record Year for International Patent Applications in 2016; Strong Demand Also for Trademark and Industrial Design Protection." http://www.wipo.int/pressroom/en/articles/2017/article_0002.html

Wright, J. D., Wong-Ervin, K. W., Ginsburg, D. H., & Kobayashi, B. H. Comment of the Global Antitrust Institute, George Mason University School of Law, on the Korea Fair Trade Commission's Amendment to Its Review Guidelines on Unfair Exercise of Intellectual Property Rights (January 3, 2016). *George Mason Law & Economics Research Paper*, 16(1). Available at SSRN: https://ssrn.com/abstract=2710281 or http://dx.doi.org/10.2139/ssrn.2710281

국문 초록

특허억류·실시료 과적 이론과 표준필수특허

서울대학교 대학원
경제학부 경제학 전공
김 성 이

본 논문은 지적재산권 관련 최신 논의를 Lemley and Shapiro(2007)의 특허억류(patent holdup)와 실시료 과적(royalty stacking) 이론을 적용하여 살펴보고, 특히 표준필수특허 상황 하에서는 어떠한 문제점들이 발생하는 지 분석했다. 본 연구는 다음과 같은 두가지 결과를 도출했다. 첫째로, 실시권자가 표준필수특허를 이용하게 되면 기술 수용 이후 제품 설계 변경이 불가능하기 때문에 금지청구권 위협으로 인한 특허억류 효과가 증폭되며, 열등한 기술이 선택되어 사회적 후생이 감소할 수 있다는 것을 밝혔다. 둘째로, 실시료 한도(cap) 정책과 FRAND 선언이 특허권자의 권리남용을 제한함으로써 위의 부정적인 결과를 완화시킬 수 있다는 것을 밝혔다. 본 논문은 실시료와 라이선싱 조건에 대한 데이터가 제한적이기 때문에 특허억류·실시료 과적현상의 존재와 규모를 실증적으로 분석하기 위해서는 추가적인 연구가 필요하다는 한계를 지니고 있다.

주 요 어: 표준필수특허, 특허억류, 실시료 과적, FRAND 확약, 실시료 한도

학 번: 2015-22506