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Problems in Sharing the Surplus

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I. Introduction

Dennis Carlton and Allan Shampine have addressed opportunistic and strategic behavior by standard-essential patent owners.[1] After a standard has been specified, and sunk investments have been made by those who would implement the standard, the holder of a standard-essential patent can demand more for the patent license than it could have demanded *ex ante*.[2] This sort of *ex post* opportunism can lead to economically inefficient outcomes.[3] The solution is to limit such patent holders to "fair, reasonable, and non-discriminatory" (FRAND) patent license fees.[4] Carlton and Shampine have advanced our understanding of precisely what this means.

License fees are negotiated with individual downstream producers, typically after the standard has been adopted. As a consequence, downstream producers may

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1 Dennis W. Carlton & Allan L. Shampine, *An Economic Interpretation of FRAND*, 9 J. COMPETITION L. & ECON. 531 (2013).

2 *Id.* at 534.

3 *Id.* at 535.

4 On the implications of FRAND see Rebecca Haw Allensworth, *Casting a FRAND Shadow: The Importance of Legally Defining "Fair and Reasonable" and How* Microsoft v. Motorola *Missed the Mark*, 22 Tex. INTELL. PROP. L.J. (forthcoming 2014); Thomas F. Cotter, *The Comparative Law and Economics of Standard-Essential Patents and FRAND Royalties*, 22 TEX. INTELL. PROP. L.J. (forthcoming 2014); Keith N. Hylton, *A Unified Framework for Competition Policy and Innovation Policy*, 22 TEX. INTELL. PROP. L.J. (forthcoming 2014); William H. Page, *Judging Monopolistic Pricing: F/RAND and Antitrust Injury*, 22 TEX. INTELL. PROP. L.J. (forthcoming 2014); D. Daniel Sokol & Wentong Zheng, *FRAND in China*, 22 TEX. INTELL. PROP. L.J. (forthcoming 2014); Christopher S. Yoo, *Standard-Setting, FRAND, and Opportunism*, 22 TEX. INTELL. PROP. L.J. (forthcoming 2014).

become locked into using a particular standard before royalties are negotiated.[5] The *ex post* negotiation of royalties gives the owners of standard-essential patents the ability to demand larger royalties than they could have *ex ante*.[6] Without standard-specific investments, patent holders are only able to demand compensation equal to the *ex ante* marginal value added by their patented technology.[7] Otherwise, final producers would simply adopt an available alternate technology, and the original patent holder would receive nothing. The goal of FRAND royalty rates is to restore this *ex ante* solution.

Imposing FRAND commitments is intended to reduce the likelihood that the owner of a standard-essential patent can hold up a licensee by demanding "excessive" compensation for the intellectual property after standard-specific investments have been made by a potential licensee.[8] When a standard is being negotiated by a Standard-Setting Organization (SSO), owners of standard-essential patents must agree to license their intellectual property under FRAND terms.[9] If they will not, the SSO would consider tweaking the standard to include an alternative technology.[10] This process is supposed to limit the market power conferred upon the owners of standard-essential patents and reduce their ability to charge supra-competitive royalty rates after their intellectual property becomes required by industry producers.

Carlton and Shampine point out that confusion exists around determining what exactly constitutes a FRAND royalty rate, and they advance our understanding of how to apply economic reasoning to solving some of those issues. Most of the confusion centers around the definitions and feasibility of the terms "reasonable" and "non-discriminatory." A reasonable rate is one that would arise in a competitive market for the technology in question, limiting the patentee's *ex post* market power.[11] A non-discriminatory rate is one that does not distinguish between two similarly situated firms.[12] That is, when the technology in question similarly reduces two firms' costs—or alternatively, enhances their products' respective market values—the non-discriminatory principle would entail each firm paying the same royalty rate.[13] This article focuses on the reasonableness principle and the difficulty in identifying and implementing a reasonable royalty rate.

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5 Carlton & Shampine, *supra* note 1, at 535.

6 *Id.*

7 *Id.*

8 *Id.* at 537 ("By exploiting [the *ex post* bargaining position] or enhanced market power to raise royalty rates, the patent holder can hold up the prospective patent licensees and extract excessive royalties.").

9 *Id.* at 544–45.

10 *Id.*

11 Carlton & Shampine, *supra* note 1, at 536.

12 *Id.* at 541.

13 *Id.*

Instead of focusing on *ex post* opportunism, this article addresses *ex ante* bargaining problems. Economic analysis can characterize the incentives of different parties in a unique bargaining situation, but it often does not have the ability to predict a unique outcome. In many cases, economic analysis can identify particular bargaining outcomes that are unlikely, but it cannot select one of the remaining possible allocations as more likely than the others. In the context of FRAND royalty rates, failing to identify a unique bargaining solution implies that selecting one must be at least somewhat arbitrary. An arbitrarily selected rate cannot be considered reasonable.

The remainder of this article is organized as follows. Section II examines the difficulty that economic analysis has in predicting a unique bargaining solution and presents a number of different market arrangements that affect that prediction. Section III briefly explores the possible resort to eminent domain and compulsory licensing. As will be shown, neither of these approaches solves the problem. Section IV closes with concluding remarks.

II. Dividing the Surplus

While commitments to charge FRAND royalties deal with *ex post* strategic behavior designed to garner larger shares of the surplus created by an industry standard, there are *ex ante* bargaining problems that may undermine the creation of the surplus that an agreement would permit. The goal of adopting FRAND principles cannot simply be to restore a desired *ex ante* allocation because there may not be a unique *ex ante* allocation to restore. Some of the economic insights related to sequential bargaining, the time cost of negotiations, and the role of substitutable technologies are presented below. In each of these cases, basic economic intuition fails to select one particular rate—the reasonable rate.

Final producers and patentees must negotiate licensing fees, effectively bargaining over an amount of potential profits. If an agreement is reached, the surplus is realized, and it is distributed according to the agreement. If an agreement is not reached, the surplus is not realized, and no one receives any revenue (at least until the next time period). The following section identifies potential outcomes of the bargaining process and considers issues that may affect the distribution of any resulting surplus. It focuses most closely on the difficulties in predicting a particular division of the resulting surplus.

Economic analysis offers insight into what the upper and lower bounds of a patent license fee may be, but it often cannot predict a particular license fee within that set of possibilities. The inability to predict a single solution arises from the joint creation of surplus by a downstream producer and the owners of intellectual property employed by the producer as well as the multitude of potential bargaining structures.

When a downstream producer utilizes patented technology, it earns a return above what it would earn without utilizing that technology. Otherwise, the down-

stream producer would not be willing to pay for the technology. These increased profits must be split between the producer and the owner(s) of the patented technology. There is no universal rule regarding how these additional profits are to be distributed between the producer and the patentee(s). Any prediction must consider the unique features of a particular licensing arrangement and the ensuing bargaining process, including the number of protected technologies and the availability of alternatives to each.

The simplest illustration of this problem involves bargaining between a downstream monopolist producer and an owner of intellectual property that is essential for producing a final good, each with no outside option.[14] The downstream producer cannot operate without the patentee's protected technology, and the patentee cannot earn a return on its intellectual property without licensing it to the downstream producer. Suppose that the product will yield $100 of profit, and the patentee offers to license its technology for $90. The downstream producer would accept the offer because the offer provides it with $10 of additional profit. Suppose, however, that the downstream producer had offered the patentee $10 for its intellectual property. Again, the offer would be accepted because that offer provides the patentee $10 of additional surplus.

This simple bargaining scenario is referred to as an Ultimatum Game, and it reveals the difficulty of identifying who is entitled to profits generated by the use of a patented technology.[15] The standard Ultimatum Game involves two economic agents—"players"—that are trying to divide a fixed sum of money. The first player proposes a division of the money. Observing this proposal, the second player either accepts the division or rejects it. Rejecting the division leads to neither player receiving any payoff. In this setting, it is predicted that the first player will offer a highly inequitable division of the money because he or she knows that the second player will accept anything that offers even a very small amount of money.

The Ultimatum Game setting fits the simple bilateral monopoly example quite well, but it omits one critical issue of practical import: who is the first player? Despite the intuitive prediction offered by the Ultimatum Game, it says nothing regarding which player makes the initial offer and which player is stuck in the unfortunate position of simply accepting or rejecting an offer. In the bilateral monopoly case, both the upstream patentee receiving most of the surplus or the downstream monopolist receiving most of the surplus constitute reasonable divisions. Selecting between these possibilities requires precise knowledge regarding the structure of bar-

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[14] This market arrangement is referred to as a bilateral monopoly. For the foundational contribution, see A. L. Bowley, *Bilateral Monopoly*, 38 ECON. J. 651 (1928). *See also* Roger D. Blair, David L. Kaserman & Richard E. Romano, *A Pedagogical Treatment of Bilateral Monopoly*, 55 S. ECON. J. 831 (1989).

[15] *See generally* John Gale, Kenneth G. Binmore & Larry Samuelson, *Learning To Be Imperfect: The Ultimatum Game*, 8 GAMES & ECON. BEHAV. 56 (1995).

gaining. This feature of reality renders the Ultimatum Game framework incapable of predicting a unique bargaining allocation.

Without a clear understanding of the unique features of a particular bargaining arrangement between downstream producers and patentees, economic analysis fails to predict a unique licensing royalty that should arise. This point is made clear with the simple example of a single downstream producer and a single patentee, each without an outside option. This article explores how this problem evolves as the number of patentees increases, but again, economic analysis will fail to identify a single reasonable royalty rate.

A. Multiple Patented Technologies and Sequential Bargaining

Innovative products often utilize many patented technologies. These technologies may or may not be held by the downstream producers, or even by a single patentee. Some products require hundreds, or even thousands, of patented components. Steve Jobs claimed that the Apple iPhone, upon its initial unveiling, incorporated more than 200 patented innovations,[16] while the Toyota Prius is protected by more than 2,000 patents.[17] Final producers typically do not own the rights to each of these patented technologies. Rather, they rely on licensing agreements with numerous patentees to produce their final products. This creates a multi-party bargaining situation that is, in some ways, more complicated than the simple case illustrated above.

The simple case of a monopolist downstream producer and a single patentee illustrates the difficulty of predicting how surplus might be divided between final producers and the owners of intellectual property. The situation becomes even murkier with the introduction of two or more blocking patents. Suppose that producing a hammer required the use of patented handles and patented heads. If intellectual property rights protect both the handles and heads, along with the production of the hammer itself, each bargaining entity can claim that its technology is worth the entire surplus created by the production of hammers. Without any one of the three protected technologies, the hammer cannot be produced, and the associated surplus is not realized. The parties must identify an acceptable allocation of the surplus, or everyone is made worse off.

When the Ultimatum Game introduced above is expanded to include three players, it provides similar predictions to the two-player version. Additionally, it leaves us with little insight regarding how surplus might actually be divided. The three-player game is characterized as follows:

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[16] Ryan Block, *Live from Macworld 2007: Steve Jobs Keynote*, ENGADGET (Jan. 9, 2007), http://www.engadget.com/2007/01/09/live-from-macworld-2007-steve-jobs-keynote/.

[17] John Murphy, *Toyota Builds Thicket of Patents Around Hybrid To Block Competitors*, WALL ST. J., http://online.wsj.com/news/articles/SB124640553503576637 (last updated July 1, 2009, 11:59 PM).

First Move:	*The first player proposes a division of a fixed sum of money.*
Second Move:	*The second player chooses to accept or reject the first player's proposed division. If the second player accepts, that player proposes a division of the remaining surplus—the portion not claimed by the first player—to the third player. If the second player rejects, the game is over, and the fixed sum of money disappears.*
Third Move:	*The third player chooses to accept or reject the second player's proposed division. If the third player accepts, the fixed sum of money is distributed according to the two previous proposals. If the third player rejects, the game is over, and the fixed sum of money disappears.*

Consistent with game theory analysis of sequential move games, the solution to this bargaining problem is analyzed by solving it backwards.[18] This solution approach is preferred because, as the bargaining game progresses, each player can anticipate subsequent players' responses.

At the final point in the bargaining game, when the third player chooses to accept or reject a proposal by the second player, the third player will choose to accept any proposed division that offers that third player a positive payoff. Otherwise, that player receives no payoff. Similarly, when the second player chooses whether to accept or reject a proposal by the first player, the second player will choose to accept any proposed division that offers the second player a positive payoff. Moreover, anticipating the third mover's response, if the second player accepts the first player's proposed division, that second player will offer a very small portion of its allocation to the third player. This anticipated behavior leads the first player to make an initial proposal in which it receives most of the surplus. Such a proposal will be accepted by both bargaining partners subsequently. As in the two-player Ultimatum Game, the first player is able to extract almost the entire surplus. In the patent licensing arena, this result implies that the first party to make an offer receives most of the profits associated with the patent-protected final product, but it also implies that the final product is produced. Hold-up problems are avoided. This approach disregards the role of counteroffers and the more dynamic process that bargaining actually may be.[19]

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[18] This is also known as backward induction. *Backward Induction*, ECONPORT, http://www.econport.org/econport/request?page=man_gametheory_backinduct (last visited Aug. 31, 2014).

[19] This setting does not solve the question of which player is the first player. Game theory still fails to predict which bargaining partner is able to extract most of the surplus.

Practical bargaining situations involve counteroffers. Continuing with the hammer example, the owner of the patent on heads might demand $90 of the surplus, leaving the other $10 to be divided by the owner of the handle patent and the downstream producer. In a simple accept-reject Ultimatum Game, this offer would be accepted. The product would be produced, and there would be no incentive for the owner of the handle patent or the downstream producer to engage in hold-up. Unfortunately, this setting is highly unrealistic. In reality, the owner of the handle patent could make a counteroffer, demanding $90 of the surplus for itself. Until no counteroffers are possible, this process could continue indefinitely. The initial player loses any bargaining power it had enjoyed in the Ultimatum Game that did not allow counteroffers.

We examine the role of counteroffers by extending the Ultimatum Game to include counteroffers and demonstrate that it provides a new prediction regarding who secures the majority of the surplus. The three-player game with counteroffers is characterized as follows:

First Move:	*The first player proposes a division of a fixed sum of money.*
Second Move:	*The second player chooses to accept the first player's proposed division or to make a counteroffer. If the second player accepts, that player proposes a division of the remaining surplus—the portion not claimed by the first player—to the third player. If the second player makes a counteroffer, the game begins anew.*
Third Move:	*The third player chooses to accept the second player's proposed division or make a counteroffer (assuming the second player has accepted the first player's offer). If the third player accepts, the fixed sum of money is distributed according to the two previous proposals. If the third player makes a counteroffer, the game begins anew.*

The introduction of counteroffers complicates game theory analysis by allowing the game to start anew whenever one of the bargaining parties is not satisfied with the offer it receives. Solving the game backwards is no longer possible because there is no longer a clear final player. Any player can avoid being the final player by simply making a counteroffer. Game theory is no longer capable of making a prediction.

Allowing for counteroffers removes the ability of any bargaining party to place others in a take-it-or-leave-it position. As a consequence, any party can engage in hold-up. Returning to the hammer example—with both patented handles and

heads—each of the three parties might believe that they deserve the entire surplus. The owner of the patent on hammer heads could legitimately argue that the other two patented technologies are valueless without a license to use the head technology. The owner of the patent on hammer handles, as well as the downstream producer, could make similar claims. In the presence of counteroffers, each bargaining party could demand the entire surplus, leading to the surplus associated with production never being realized. The hold-up problem remains.

In each of the examples above, economic analysis and game theory analysis fail to predict a particular division of the surplus, but a number of interesting issues arise. First, when bargaining is sequential and counteroffers are not feasible, the first party to make an offer can extract the majority of the surplus. In this particular setting, there is no hold-up problem, and the final product is produced. There is, however, the problem of predicting the identity of the first mover. Essentially, the game theory analysis predicts that *someone* will be able to extract the entire surplus by moving first. Second, when counteroffers are possible, game theory analysis offers even less predictive capability. It is unable to predict a particular division of the surplus, and even more critically, it is unable to predict that an agreement will even be made. In the presence of counteroffers, it is possible that hold-up behavior could result in the surplus never being realized.

We have shown that the reasonable principle fails to select a particular allocation of surplus. This point is most evident when there exists one or more blocking patents. All owners of blocking technologies, as well as downstream monopolists, can reasonably claim that they are entitled to the entire surplus. These claims would be reasonable, but they would cause the parties to fail to reach an agreement. Additionally, economic intuition fails to predict a particular allocation under a structured bargaining regime. It is likely that one party can obtain a favorable distribution by making the final offer. However, identifying that party is not possible.

Models of sequential bargaining are useful when the sequence of offers is fixed and known, but patent royalty rate negotiations are not so rigidly structured. In fact, few business negotiations are. Without assuming an unrealistic bargaining structure, we are left without the ability to identify a unique allocation or a reasonable royalty rate. The Ultimatum Game framework can be useful in examining observed behavior, but it does not provide the predictive capabilities that are necessary for identifying a unique bargaining solution in more realistic settings. Below, this article considers a few potential solutions to this problem. It examines the time cost of negotiating and the role of substitute technologies.

B. Time Cost of Negotiating

When final producers and patentees negotiate royalties, it can be difficult to identify a reasonable allocation of the resulting surplus.[20] In many instances, the

[20] *Compare* Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 2005–08 (2007) (discussing how licensing negotiations between patentees and multiple

sum of reasonable claims by the bargaining firms exceeds the total available surplus.[21] This creates a hold-up problem that prevents the final product from being produced if it is not resolved.[22] Here, we consider the ability or inability of the time cost of negotiating to eliminate this problem.

Most patent royalty negotiations involve agreements over multiple years.[23] The negotiation can cover the remaining duration of the patent.[24] Therefore, negotiations are not over a single fixed sum of profits, they are over a stream of profits. This practical feature is important because it implies that the time spent negotiating is not free. The potential amount of surplus declines as bargaining continues, and if an agreement is not reached quickly, the size of that decrease may be considerable. However, this does not change the incentives of firms in a way that solves the hold-up problem.

Arguably, as the stream of profits declines, bargaining parties should be more likely to arrive at a decision to which all parties can agree. The total pie to split among them is declining as bargaining goes on. Economic analysis that assumes bargaining occurs in discrete increments of time may show that the cost of not reaching an agreement disciplines the bargaining parties into accepting less attractive offers. This would ultimately lead them to agree to an equitable division at the beginning of the negotiation process. This result is attractive because it identifies a unique reasonable royalty rate, but it relies on the unrealistic assumption of discrete time periods.

Time is continuous. Failing to reach an agreement at a particular moment in time does not imply that the negotiations must be put on hold until the end of a time period. When a bargaining party does not accept a proposed agreement, that party can immediately make a counteroffer, implying that their rejection does not lead to a large instantaneous reduction in the potential stream of profits. Unfortunately, delay for a few seconds does not discipline anyone. This story is analogous to a Prisoner's Dilemma in which individual incentives do not align with collective incentives.[25] Here, the incentives of an individual bargaining party at a particular moment in time do not coincide with the incentives of the group of bargaining firms. While the total pie continues to shrink, each bargaining party continues to demand a larger share.

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downstream firms may raise negotiated royalty rates), *with* Einer Elhauge, *Do Patent Holdup and Royalty Stacking Lead to Systematically Excessive Royalties?*, 4 J. COMPETITION L. & ECON. 535, 561–63 (2008) (discussing how licensing negotiations between patentees and multiple downstream firms may lower negotiated royalty rates).

21 *E.g.*, Carlton & Shampine, *supra* note 1, at 538–41.

22 *Id.*

23 Abhinay Muthoo, *Bargaining Theory and Royalty Contract Negotiations*, 3 REV. OF ECON. RES. ON COPYRIGHT ISSUES 19, 22–23 (2006).

24 *Id.*

25 BLACK'S LAW DICTIONARY 1314–15 (9th ed. 2009).

The time cost of negotiating does not solve any hold-up issues for two reasons. First, it does not alter the balance of bargaining power. Each firm can still reasonably lay claim to the same fraction of the overall surplus. Second, the cost of waiting is not incredibly high because negotiations are a quick and dynamic process. While the entire negotiation may last a few months or even a year, one particular firm's counteroffer takes very little time. That is, negotiations are quick at the margin. Below, this article discusses the role of substitutable technologies.

C. Substitutes to Patented Technologies

Not all patented technologies are blocking. Many protected technologies have imperfect substitutes that a downstream producer can employ if an agreement is not reached. These substitutes render the patent less valuable, placing a constraint on what portion of the final surplus an owner of the protected technology can demand. This narrows the set of possible allocations of the surplus. It does not, however, select a single allocation as fair and reasonable.

Substitutes to protected technologies reduce the value of the protected technologies. A patent's maximum worth is the marginal value it adds to the final product.[26] The value added comes from either raising the quality of the final product or reducing production costs.[27] Regardless of whether the value comes from the quality-enhancing or cost-reducing channel, the substitutable technology has the same effect. The value of the patented technology falls because it may no longer be able to hold up the entire production process.

Substitutes can, in certain instances, remove a patentee's ability to block production of a final product. To begin, we revisit the simple bilateral monopoly case with an upstream patentee and a downstream monopolist producer. Suppose that producing the final good results in $100 of profits. That means there is a $100 surplus to be divided. As discussed above, each firm can reasonably demand the entire surplus, but this creates a potential hold-up problem. If neither firm accepts less than $100, an agreement is not reached, and the product is not produced. In fact, if the sum of their demands exceeds the amount of surplus created, no agreement is reached.

Now suppose that we introduce an alternative to the upstream patentee's technology. Assume that the alternative reduces the amount of available surplus to $80—possibly by increasing the downstream monopolist's costs by $20. In this setting, the patentee can only demand $20, implying that any reasonable demand it can make leaves positive profits for the downstream monopolist. The patentee cannot hold up production. This feature may be appealing and lead observers to the mistaken conclusion that substitutable technologies can solve the patent hold-up problem.

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[26] Carl Shapiro, *Injunctions, Hold-Up, and Patent Royalties*, 12 AM. L. & ECON. REV. 280, 286 n.12 (2010).

[27] *Id.*

Substitutable technologies can narrow the range of reasonable surplus allocations and limit the potential efficiency losses that arise when no agreement is reached. However, they do not identify a single reasonable licensing fee, nor do they ensure economically efficient production. Whether there are substitutable technologies or not, the desirability of reaching licensing agreements arises from the ability to generate the maximum possible amount of surplus. While the patentee in the above example cannot hold up the production of the final product, the patentee can halt the creation of $20 of surplus. It is still able to limit the amount of overall surplus that arises—inefficiently!

Dividing the surplus generated by the employment of patented technologies is not always simple, and economic analysis of the process often fails to predict a unique division. This complicates the implementation of FRAND royalty rates because it implies that identifying a reasonable rate is not always possible. The reasonable principle is intended to avert hold-up by restoring the *ex ante* bargaining solution, but there may not be a single *ex ante* solution to restore.

Arguably, limiting the amount of surplus that a patentee can extract is always desirable. However, conditional on final products being produced, any *ex ante* division of the surplus may be reasonable. Game theory analysis of sequential bargaining, the role of time discounting, and the role of substitutes all fail to identify a unique *ex ante* bargaining solution. The failure of economics to select a unique allocation implies that no particular royalty rate is more reasonable than all the others. Rather, the selection of a particular rate is arbitrary, and thus, unreasonable. Below, this article briefly discusses the legal mechanisms of takings and compulsory licensing to illustrate this point more clearly.

III. Legal "Solutions"

An economic inquiry into the relationship between FRAND royalty rates and *ex ante* bargaining solutions illuminates the potential difficulty of identifying a reasonable royalty rate. The reasonable principle is put into place to prevent patentees from engaging in *ex post* opportunism, but it is unclear how avoiding such opportunism should be achieved. This section briefly discusses the role of two legal mechanisms in order to illustrate the difficulty of determining what is reasonable.

A. Legal Mechanisms and the Elusive Search for Reasonableness[28]

A number of legal mechanisms are put into place in order to solve problems of hold-up. Owners of essential facilities or property can be forced to sell or license that property. Such intervention may be desirable because it solves the hold-up problem and ensures that the final product is produced. It does, however, impose a particular royalty rate that may not be any more reasonable than another rate.

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[28] For an excellent survey of the law and economics of takings, see Thomas J. Miceli & Kathleen Segerson, *The Economics of Eminent Domain: Private Property, Public Use, and Just Compensation*, 3 FOUND. & TRENDS IN MICROECONOMICS 275 (2007).

When a developer must assemble parcels of land to build an airport or a shopping mall, there may be a land assembly problem. As parcels are purchased, some owners realize that they can demand considerable sums for their parcels because the development cannot proceed without their land. As a result, pasture land with a fair market value of $10,000 per acre may not be able to be purchased for less than $1 million per acre. The alert landowners have realized that by holding out they can command a share of the surplus that the developer will create with its airport or shopping mall. Often, the solution is for the developer to enlist the aid of the government. The government can condemn the land and thereby compel the landowners to sell it for fair market value as pasture land.[29] The developer reimburses the government and acquires all of the needed parcels at pasture land prices. This means, of course, that the developer need not share any of the surplus with the original landowners.

The hammer manufacturer discussed earlier faces a similar problem to the example that we have just considered. The hammer heads and the handles have nominal value as paper weights, but considerable value as components of a hammer. Could the hammer patentee seek the government's aid in solving its intellectual property assembly problem? If so, the hammer head patentee and the handle patentee would be required to sell their patents to the government at fair market value. These values would be dictated by demand conditions in the paper weight market. Thus, the hammer patentee could assemble the needed property rights at a nominal cost and not have to share much of the surplus with the former hammer head and handle patentees.

This approach solves the assembly problem because neither the hammer head patentee nor the handle patentee can hold out. Consequently, the hammers will be produced and sold, which is socially desirable. But, there is a problem with this solution. Before hammers were invented by the hammer patentee, the hammer heads and handles were only good for use as paper weights. Once the hammer was invented, their values jumped because each is a vital component of a completed hammer. The fair market value of the handle patent and the head patent should reflect this fact. If it does not, then the takings solution involves serious equity issues. Specifically, this approach solves the resource allocation problem by arbitrarily conferring nearly all of the surplus on the hammer patentee. While it is true that the components have nominal value without this hammer invention, the hammer patent is worthless without either of the components. To avoid this equity problem, the surplus must be shared among the three patentees, and we are back where we started.

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[29] This business strategy can be traced to the Fifth Amendment to the United States Constitution, which provides in relevant part that: "nor shall private property be taken for public use, without just compensation." U.S. CONST. amend. V.

Another solution involves compulsory licensing.[30] However, this approach has precisely the same issues as the takings solution. If the patentees are required to license their patents, the obvious question is at what license fee. The appropriate fee—if it is not to be confiscatory—should reflect its value. In the hammer example, this is the central problem. Since each patent is essential, the value of each patent is indeterminate. While arbitrarily imposed license fees may resolve the resource allocation problem, equity problems remain.

When bargaining fails, and bargaining parties cannot reach an agreement, legal mechanisms can force licensing of intellectual property. These legal mechanisms display the same problem that FRAND rates exhibit. They impose a single allocation when it is not clear that that allocation is more reasonable than any other allocation.

IV. Concluding Remarks

From smart phones to pharmaceuticals, many products employ numerous patented technologies. Final producers must secure the rights to utilize these protected technologies in order to bring their products to market. As discussed extensively by Carlton and Shampine, downstream producers negotiate royalty rates with the owners of intellectual property, and the process of bargaining can present issues of hold-up. In particular, royalties may be negotiated after technology-specific investments have been made by the final producer. This allows owners of technology to demand higher rates. This issue is particularly relevant in industries where standards are adopted and final producers are required to pay for protected standard-essential technologies.

Attempting to avoid *ex post* hold-up, SSOs dictate that the owners of standard-essential patents must license those patents at FRAND rates. The goal is to restore the *ex ante* rate that would have arisen without the additional market power conferred on the patentee by the inclusion of their technology in the standard. This article has highlighted the fact that royalty negotiations are a bargaining process, and there exists no unique *ex ante* solution. While game theory analysis on bargaining structure, the time cost of negotiating, and the importance of substitutable technologies can provide some assistance into identifying plausible allocations, they fail to predict one particular division of the surplus.

When bargaining over a sum of money, any allocation that leaves everyone better off than had they not reached an agreement is feasible. No allocation that satisfies that condition is any more likely or more desirable than any other. Imposing one allocation over another is arbitrary, and it is impossible to say that an arbitrarily selected royalty rate is reasonable. The definition of a reasonable rate as the single rate that restores the *ex ante* outcome is flawed because no *ex ante* outcome exists.

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[30] Thomas F. Cotter, *Patent Holdup, Patent Remedies, and Antitrust Responses*, 34 J. CORP. L. 1151, 1175–76 (2009).