Journal of Competition Law & Economics, 15(1), 690–717
doi: 10.1093/joclec/nhz008
Advance Access publication 31 July 2019

THE SMALLEST SALABLE PATENT PRACTICING UNIT AND COMPONENT LICENSING: WHY $1 IS NOT $1

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ABSTRACT

The smallest salable patent pricing unit (SSPPU) is a valuation method used as a preliminary step toward the calculation of fair, reasonable, and nondiscriminatory royalties for licenses over standard-essential patents (SEPs). Under SSPPU, royalties should reflect the value added to the smallest salable component implementing the patented invention. In this paper, we discuss policy-making proposals to convert SSPPU into a pricing rule that not only assists the assessment of SEPs' added value but also forces the specification of royalties terms as a share of component costs in SEP licensing negotiations. We call this new rule SSPPU+ and we show that it distorts the distribution of surplus between SEP owners and implementers by laying down a revenue cap on standardized technologies. Therefore, a change in the royalty basis is not neutral and $1 is not $1. Furthermore, SSPPU+ imposes uniform pricing of SEPs across different industries and does not allow SEP owners to take advantage of complementarities between technologies. This pleads against a generalization of SSPPU+ at early standardization and negotiation stages.

JEL: K21; L15; O34

I. INTRODUCTION

Fixing royalties for licenses over standard-essential patents (SEPs) is a complex issue. SEP owners often commit to licensing their technology on fair, reasonable, and nondiscriminatory (FRAND) terms. However, what constitutes a FRAND royalty is a matter of debate, both in economic theory and in legal

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scholarship.[1] Several valuation methods compete to guide the determination of appropriate royalties for SEPs.[2]

The Smallest Salable Patent Pricing Unit (SSPPU) is one of these. SSPPU was initially developed in the specific context of litigation in patent damages cases.[3] Under SSPPU, royalties should reflect the value added to the smallest salable component implementing the patented invention. In recent years, some Standard Setting Organizations (SSO) like The Institute of Electrical and Electronics Engineers (IEEE) have envisioned to use SSPPU specifically for SEPs, and to convert it into a pricing rule that not only assists the *ex post* assessment of SEPs' added value by courts in the context of patent litigation but also forces licensing parties to *ex ante* specify royalties terms as a share of component costs in SEP negotiations. We call this evolution of SSPPU toward a more specified component base at the contract formation stage SSPPU+. This new pricing method would purportedly replace current methods, which specify running royalties as a percentage of the entire market value (EMV) of the end product.

When royalties are expressed as a percentage, as is common industry practice in the ICT sector, the choice of a royalty basis is *a priori* irrelevant. Whichever of the two—the component's value or of the product's end market value—is specified, the per unit revenue for the SEP owner should be the same if the royalty percentage can be adapted. As a matter of fact, a change in the royalty basis from EMV to smallest salable component can be compensated by an inversely proportional change in the royalty rate to keep the patent holder's revenue constant. And, even if behavioral constraints may bias the negotiating parties' evaluation in one direction or the other depending on the reference point (the so-called anchoring effects), the parties are still bargaining to share the entire amount of surplus. Therefore, a change in the royalty basis should be of little importance and $1 is $1.

This, however, no longer holds true if there is a nominal limit in the royalty percentage. In this paper, we argue that high nominal royalty rates are *de facto* impossible to implement. Therefore, a change in the royalty basis is not neutral as the parties are no longer bargaining over the entire surplus. In this case, a change in the royalty basis changes the distribution of surplus and $1 is no longer equal to $1.

To understand this, recall that royalty negotiations take place in the shadow of litigation. In a FRAND litigation context, courts determine a valuation method for SEPs. Usually, this consists of fixing a royalty rate and a royalty basis. However, if the parties *ex ante* use component licensing in contractual negotiations because this is recommended or required by an SSO, some

[1] Sidak, G.J. 2013. The Meaning of FRAND, Part I: Royalties, *Journal of Competition Law & Economics*, 94: 931–1055.

[2] Some SEP holders do not charge royalties or negotiate cross-licensing deals for SEP implementation.

[3] See e.g., *Allen Archery v. Precision Shooting* [1989], 7th Cir. 1989.

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courts, though not all of them, may likely choose to defer to the parties' pretrial negotiation and to the SSO's patent policy preference as a form of industry norm, and determine a royalty rate only.[4] In this scenario, the royalty basis discussion would not even enter the scope of the trial. Behavioral bias, including anchoring or unit effects, may in turn lead some courts and juries to consider that high nominal royalty rates are "big," possibly prohibitive, while low nominal rates are more likely to look "fair."

This, however, is misguided. Courts must determine a fair valuation for a given SEP, not a fair royalty unit. When a high-valuation SEP is practiced by a low-value component, this calls for a high percentage royalty (or, in the alternative, a low unit percentage with a larger royalty base, like EMV). Behavioral constraints, though, make high nominal royalty rates under SSPPU+ look unfair. Moreover, antitrust agencies may have no other choice but to deem high nominal rates a form of unlawful exploitative pricing, in the application of strict case-law standards that deem unlawful prices that have "*no reasonable relation to the economic value of the product*" supplied.[5]

In this context, the generalized use of SSPPU+ in SEP licensing negotiations can be seen as the imposition of a *de facto* price cap on the royalty rates. Combined with a given royalty basis, it is equivalent to a revenue cap on an SEP holder licensing revenue. This revenue cap may prevent the SEP owner from collecting a fair value for its innovations. In this paper, we show that under SSPPU+, the revenue cap operates as a haircut on the bargaining range. Therefore, the parties in licensing negotiation no longer bargain over the entire surplus but over a fraction of it, the remainder being systematically captured by the licensee. This is likely to create inefficiencies.

Furthermore, if the technologies subject to SEPs are used in multiple application sectors, SSPPU+ leads to more uniform pricing of standardized technologies across industries while efficiency would call for a valuation that reflects the value added to each industry and especially the complementarities between industry-specific technologies. These important distributional effects are likely to impact the strategies of firms developing standardized technologies and the standardization process itself. We argue that this cuts against a generalization of SSPPU+ at early standardization and negotiation stages.

Our paper builds on several economic studies that criticize SSPPU as a basis for licensing because it is at odds with current industry practices, and because its generalized implementation in SEP licensing negotiation is complicated. The main arguments are as follows. First, in many SEP intensive industries, portfolio licensing is a common practice. The use of SSPPU would

[4] Note that in SEP cases, parties are often sophisticated players. This limits, though does not exclude, the risk of possible behavioral bias at the trial stage. In several past cases, courts have awarded per unit royalties without apparently falling prey to errors due to behavioral biases. See, for example, Microsoft Corp. v. Motorola, Inc., No. 10-cv-1823 (W.D. Wash.).

[5] See *United Brands v. Commission* [1978] C-27/76 EU:C:1978:22, paras 250–253.

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require to map each patent in the portfolio to a well-identified component and to determine a licensing rate. With a large portfolio of SEPs and non-SEPs, this valuation exercise is likely to impose substantial additional costs.[6] And complementarities between patents within a similar portfolio are ignored under SSPPU.

Second, while the smallest component in the SSPPU must be "salable," it does not mean that it is actually sold. Some market prices are missing when a firm is integrated. According to Putnam and William, the requirement to use the smallest *salable* component as a rule will lead to different royalty bases for an integrated firm.[7] This would complicate the comparison of royalty rates and other terms across multiple licenses, and consequently, make the monitoring of FRAND obligations more complex.

Third, manufacturers create value by combining components and part of this value comes from *complementarity* between technologies. Technology has added value beyond the component where it is included. Using the end-market value as the industry norm for licensing can be justified by the necessity to take these complementarities into account.[8] On the contrary, licensing at the component level fails to take these network effects into account. Sidak, therefore, recommends the use of the EMV as a royalty base when multiple technologies interact.

The debate on the opportunity to use SSPPU in SEP licensing echoes scholarly discussions on the appropriate choice of a royalty base. Kamien and Tauman's pioneering work compares a fixed fee licensing to percentage royalties and shows the former to be superior for creating fewer distortions on the product market.[9] San Martin and Saracho and Llobet and Padilla compare percentage royalties (*ad valorem*) and per-unit royalties, percentage royalties being equivalent to using the EMV as the royalty basis and per-unit royalties to the component value.[10] Both papers show that the choice of a royalty basis influences downstream market competition. San Martin and Saracho characterize the choice of *ad valorem* royalties as a commitment to be softer in the market competition game, therefore increasing the firms' profits. Llobet and Padilla show that the choice of a royalty basis influences the licensor's revenue, its incentive to invest and ultimately the total welfare. Therefore, per-unit royalties based on the component's value and *ad valorem* royalties based

[6] Stark, R.J. 2015. Debunking the Smallest Salable Unit Theory, *CPI Antitrust Chronicle*, 7:1–10.

[7] Putnam, J.D. and William, T.A., The Smallest Salable Patent-Practicing Unit (SSPPU): Theory and Evidence (*SSRN*, 8 September 2016) < https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2835617&download=yes\protect$\relax>$ accessed 13 May 2019.

[8] Sidak, G.J. 2014. The Proper Royalty Base for Patent Damages, *Journal of Competition Law & Economics*, 10:989–1037.

[9] Kamien, M.Y. and Tauman, Y. 1986. Fees versus Royalties and the Private Value of a Patent, *Quarterly Journal of Economics*, 101:471–492.

[10] San Martin, M. and Saracho, A.I. 2010. Royalty Licensing, Economic Letters, 107:284–287. Llobet, G. and Padilla, J. 2016. The Optimal Scope of the Royalty Base in Patent Licensing, *Journal of Law & Economics*, 59:45–73.

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on handsets' market value are generally not equivalent. In line with Sidak, they show that *ad valorem* royalties are more desirable when complementary technologies are combined.[11]

The paper is organized as follows. In Section II, we discuss the valuation methods for SEPs used in courts and SSOs, and we track the emergence of SSPPU+. In Section III, we show that the choice of a royalty basis is mostly irrelevant when the SEP royalty rate can be adjusted. In Section IV, we show that SSPPU+ is equivalent to a revenue cap on SEP royalties. In Section V, we show that SSPPU+ is equivalent to uniform pricing of standardized technologies across sectors and industries and discuss possible consequences. We conclude in Section VI.

II. FROM SSPPU VALUATION IN DAMAGE LITIGATION TO COMPULSORY COMPONENT LICENSING IN LICENSING NEGOTIATIONS

Under U.S. and European Union (EU) law, compensatory damages are due to patent owners in case of infringement.[12] Patent damages are set *ex post* on a case-by-case basis by judicial authorities and/or in arbitration proceedings. As a rule, damages should be "*appropriate to the actual prejudice suffered by him/her as a result of the Infringement*."[13] And, in no event should damages be "*less than a reasonable royalty for the use made of the invention by the infringer*."[14]

The law focuses a standard damages inquiry on either the patent owner's lost profits[15] or—more frequently—on "*the amount of royalties or fees which would have been due if the infringer had requested authorization to use the intellectual property right in question*."[16] In the second variant, the idea is to set a *reasonable royalty*. When an established royalty or fee is unavailable, the examiner attempts to reconstruct the outcome of a *hypothetical negotiation* between the patent owner and the infringer.

Courts use a variety of methods to calculate patent damages. In *CSIRO v Cisco*, the Court of Appeals for the Federal Circuit noted that "*damages models are facts dependent*."[17] A central tenet of patent law is that damages should reflect "*the value attributable to the infringing features of the [infringing] product*

[11] Sidak, *supra* note 8.

[12] See 35 U.S. C. § 284 and Directive 2004/48/EC of the European Parliament and of the Council of 29 April 2004 on the enforcement of intellectual property rights, Article 13(1) (hereafter EU Enforcement Directive)

[13] EU Enforcement Directive, Article 13(1).

[14] 35 U.S. C. § 284.

[15] Lost profits cover lost sales, price erosion effects, and additional costs like litigation expenses for instance.

[16] See EU Enforcement Directive, Article 13(1)(b).

[17] *Commonwealth Scientific and Industrial Research Organisation ('CSIRO') v. Cisco Systems* [2015], 809 F.3d 1295 (Fed. Cir. 2015).

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and no more."[18] This is known as the rule of "*apportionment*."[19] Yet, when multicomponent products are involved apportionment can be tricky. In such cases, damages claimants have two options. First, they may propose to use the EMV of an end product as the appropriate royalty *base* when the patented component is the "*basis for demand*" for that entire product.[20] The following point in the inquiry consists in finding a reasonable royalty *rate*—a flat or percentage fraction of the end-product price—that captures the incremental value brought by the patented invention to the end product. In contrast, when the patented invention does not exclusively drive demand for the end product, a *more realistic point* for the royalty base may be the value of the component, the subassembly, or the integrated circuit that implements the patent claim. The inquiry thus uses the value of the "*smallest salable patent practicing unit*." ("SSPPU") as the appropriate royalty base, and in turn attempts to calculate a *rate* that reflects the *incremental value* of the patented invention.

In practice, there is some uncertainty on which of EMV or the SSPPU should be the default royalty base for the calculation of compensatory damages cases. In the United States, decisions of the Federal Circuit suggest "*as a general matter, [that] the base should not be the 'entire market value.*" However, in *CSIRO v Cisco*[21], the Federal Circuit also noted that SSPPU is untenable as a mandatory rule but an acceptable option when the facts fit the approach. It stressed its derogatory nature, insisting that "*licensed based evidence*" remains the preferred method when rates for comparable licenses are available.[22]

Courts, however, are more concordant over the fact that the EMV v SSPPU discussion is largely irrelevant outside of the specific scenario of jury trial cases, and therefore more relevant in the United States than in the EU where bench trials are the rule.[23] This is because jury trials present a "*unique apportionment concern*."[24] When nonexpert juries are called to set reasonable royalties, the use of the EMV method may mislead juries into *overcompensation* by making the claimed royalty look low. The use of such base "*cannot help but skew the damages horizon for the jury*"[25] and "*make a patentee's proffered damages amount appear modest by comparison*."[26] Stark notes that SSPPU was developed to offset a

[18] *Ericsson v. D-Link* [2014], 773 F.3d 1201 (Fed. Cir. 2014).

[19] This problem essentially occurs in practice with running royalties calculated on units produced or sold, as opposed to a lump sum royalty.

[20] Blair, R.D. and Cotter, T.F. 2005. *Intellectual Property: Economic and Legal Dimensions of Rights and Remedies*. Cambridge: Cambridge University Press.

[21] *CSIRO v Cisco*, *supra* note 17.

[22] Although this is very uncommon, see Blair and Cotter, *supra* note 20, p. 211.

[23] *CSIRO v Cisco*, *supra* note 17, a bench trial, was conducted under the EMV.

[24] Snyder, M. 2015. SSPPU: A Tool for Avoiding Jury Confusion, paper presented at the Sedona Conference.

[25] *Uniloc USA v. Microsoft* [2011], 632 F.3d 1292 (Fed. Cir. 2011), at pp. 51–52.

[26] *LaserDynamics v. Quanta Computer* [2012], 694 F.3d 51 (Fed. Cir. 2012).

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"*perceived tendency of jurors to overestimate reasonable royalties that might be agreed to in hypothetical negotiations*."[27]

Nevertheless, the narrow, jury-specific and *ex post* nature of SSPPU may be brought to a whole new level. As Kappos and Michel note: "*it has become fashionable to refer to SSPPU as a substantive rule defining the appropriate royalty base for all purposes and in all contexts*."[28] In particular, two strands of uncoordinated policy initiatives could lead to a generalization of SSPPU, in particular in *ex ante* patent licensing negotiations. On the one hand, one prominent SSO has proposed to use SSPPU as the appropriate valuation method in all *ex ante* patent licensing negotiations over SEP covered by a FRAND commitment.[29] In 2014, the Institute of Electrical and Electronics Engineers Standards Association ("IEEE-SA") updated its patent policy and introduced the idea that FRAND royalty terms should reflect the *"value that the functionality of the claimed invention or inventive feature . . . contributes to the value of the relevant functionality of the smallest saleable Compliant Implementation that practices the Essential Patent Claim*." The IEEE-SA initiative is predicated on the policy view that SEP royalties are too high and on academic concerns of market failures known as "*patent holdup*" and "*royalty stacking*."[30] In practical terms, the IEEE-SA suggests linking the valuation discussion to the smallest component that implements the patent. Also, it proposes to look at the smallest salable component as a proxy for the value of the infringing feature, and thus suggests that the sale price or purchase cost of a component is the appropriate valuation base. Unsurprisingly, the IEEE-SA initiative was received with mixed feelings among practitioners.[31]

On the other hand, several contemporary antitrust, policy, or regulatory initiatives seem to lean toward a generalization of component licensing as the *pricing* rule of practice for bilateral SEP negotiations. Component licensing means using the SEP implementing component as the appropriate royalty base, not only for the *valuation* of the technology but also for the *specification* of the royalty term. Let us explain this with an example. Consider an SEP (or a portfolio thereof) that covers wireless connectivity technology for an airlines' in-flight entertainment sets. Having calculated the added value to the smallest salable component under the IEEE-SA valuation method, here a radio

[27] Stark, *supra* note 8.

[28] Kappos, D.J. and Michel, P.R. 2018. The Smallest Salable Patent-Practicing Unit: Observations on Its Origins, Development, and Future, Berkley Technology Law Journal, 32:1433–1455.

[29] Note that in some sectors, such as wireless communications, SEPs licensing occurs on a global scale. Thus, the proposed expansion would lead to the introduction of SSPPU well beyond the United States.

[30] Lemley, M.A. and Shapiro, C. 2007. Patent Holdup and Royalty Stacking, Texas Law Review, 85:1991–2049.

[31] Katznelson, R. (2016). *The IEEE controversial policy on Standard Essential Patents—the Empirical Record since Adoption*, Mimeo; Sidak, G.J. 2015. Bargaining Power and Patent Damages, Stanford Technology Law Review, 19:1–31.

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frequency (RF) chipset, the SEP owners and implementers can in principle agree to specify the royalty term as a share of the (i) RF chipset, (ii) in-seat video screen, (iii) seat, or (iv) the aircraft. Under component licensing, no such freedom exists. The parties are compelled to choose the RF chipset as the appropriate royalty base and specify a royalty term on that base.

Component licensing-spirited initiatives follow distinct, uncoordinated routes. In 2016, South Korea's antitrust decision maker ruled that Qualcomm had abused of its dominant position by refusing to license FRAND-pledged SEPs to modem chipset companies, and instead unlawfully followed a practice of licensing its SEPs only at the end-user device level.[32] In the EU, a policy discussion has been taken place before the European Commission as to whether the "*ND*" limb of FRAND implies that owners of SEPs declared to the European Telecommunications Standards Institute (ETSI) have a contractual or regulatory duty to license "*at all levels*."[33] In relation to Internet of Things (IoT) devices, some studies suggest that percentage royalties on final products are not appropriate because the connectivity technology is ancillary. A corollary of that interpretation would be to proscribe SEP owners from licensing only at the end-user device level. And, in the United States, Apple[34] and the Federal Trade Commission (FTC)[35] have separately complained before the Federal Courts that Qualcomm calculates royalties as a percentage of a handset's price, even though handsets today offer a number of features—including cameras, high-resolution touchscreen displays, powerful applications, and graphics processors—other than cellular connectivity. In the first (recently settled) case, Apple argued that Qualcomm charged an exorbitantly high royalty "*expressed as a percentage of the entire market value of the finished device*." Apple claimed that Qualcomm's practice violated patent law, Qualcomm's FRAND obligation, and distorted the fundamental premise of "*allowing competitors who implement the standards access to the SEPs on a level playing field, with no one competitor paying more for the same technology than others*."[36] In the second case, Judge Koh granted the FTC motion for partial

[32] Qualcomm, KFTC issued a press release—unofficial English Translation (*Qualcomm*, 28 December 2016) <https://www.qualcomm.com/documents/kftc-issued-press-release-dated-december-28-2016-unofficial-english-translation> accessed 13 May 2019.

[33] Huber, B. *Why the ETSI IPR Policy Does Not and Has Never Required Compulsory 'License to All': A Rebuttal to Karl Heinz Rosenbrock* (2017). Available at SSRN. Karl Heinz Rosenbrock, *Licensing At All Levels Is The Rule Under The ETSI IPR Policy: A Response to Dr. Bertram Huber* (2017). Available at SSRN. In its latest Communication of 29 November 2017 covering the issue of SEP licensing, the EU Commission has declined to take an explicit stance on the issue. See Communication from the Commission to the Institutions on Setting out the EU approach to Standard Essential Patents, COM(2017) 712 final. Note that this Communication does not "bind the Commission as regards the application of EU rules on competition."

[34] Complaint, *Apple Inc. v Qualcomm Inc.* [2017], C 3:17-cv-00108-GPC-NLS (hereafter Complaint, *Apple Inc. v. Qualcomm Inc.*).

[35] See *FTC v Qualcomm Inc.* [2017] C 5:17-cv-00220-LHK.

[36] Complaint, *Apple Inc. v Qualcomm Inc.*, §142–145

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summary judgment, noting that as a matter of (contract) law, Qualcomm was under a FRAND duty to license its SEPs to modem chip suppliers, and could not refuse to license its SEPs to applicants, like modem chip suppliers, that only produce components of devices.[37] In her final opinion, Judge Koh took issue with Qualcomm's policy device level licensing-only to OEMs on antitrust grounds. The Court held that Qualcomm's refusal to license its SEPs to rival modem chip suppliers constituted cognizable anticompetitive conduct under the Sherman Act. Judge Koh ordered Qualcomm "*to make exhaustive SEP licenses available to modem-chip suppliers on fair, reasonable, and nondiscriminatory terms*."[38]

In effect, all these legal and policy developments bear potential to generalize component licensing as the rule in SEP licensing negotiations, a more than incremental evolution that was not obvious following the IEEE-SA initiative. This is why we call this evolution SSPPU+.

In practice, SSPPU+ would augur a sea change in markets where portfolio licensing at the end-user device level had been industry practice, and in particular in the wireless communications industry.[39]

III. SSPPU, THE BARGAINING RANGE AND THE NEUTRAL DISTRIBUTION OF ECONOMIC SURPLUS

This section explains that the application of SSPPU in an industry should be indifferent from a mathematical standpoint (A). Certainly, the existence of behavioral biases leads parties to an SEP negotiation to bargain within a different range of nominal valuations for the technology depending on the royalty basis (B). Yet, this effect is of little concern (if anticipated at the time of entry in the industry) because it does not affect the distribution of economic surplus between SEP owners and implementers (C). In theory, $1 is $1 and the choice of a royalty basis should be neutral.

A. The Neutrality of Multiplication

Let us consider an industry in which an SEP owner and a multicomponent product manufacturer negotiate percentage royalties. The total royalty revenue

[37] See, United States District Court, Northern District of California, Order Granting Federal Trade Commission's Motion for Partial Summary Judgment, *FTC v Qualcomm Inc*, C 17-CV-00220-LHK, 11–06-18.

[38] See, United States District Court, Northern District of California, Finding of Facts and Conclusions of Law, *FTC v Qualcomm Inc*, Case No. 17-CV-00220-LHK, 05–21-19.

[39] In the wireless communications sector, royalties are typically calculated on the basis of the selling prices of licensed products, rather than as a percentage of the selling price of either chipsets or cellular service. See Stasik, E. 2010. Royalty Rates and Licensing Strategies for Essential Patents on LTE (4G) Telecommunications Standards, *Les Nouvelles*, 114–119.

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that the SEP owner can expect is equal to the royalty rate multiplied by the royalty base:

$$\text{Royalty revenue} = \text{royalty rate } x \text{ royalty base} \quad (1)$$

From an arithmetical standpoint, any change to the factor *royalty base* is neutral on the product of the multiplication as long as the factor *royalty rate* can be adjusted. This can be shown with a simple example. Consider a standard essential technology that is embodied in a chipset with a cost (value) of $10.[40] The chipset is integrated into a handset with a retail value of $1,000. Assume that the incremental value brought by the technology to the handset is $50 and that both the SEP owner and the handset manufacturer agree upon that figure. The parties can conclude a licensing agreement that provides for a 5 percent royalty rate on the end-product value. Alternatively, the parties can contract a 500 percent royalty rate on the cost of the chipset. A change in the royalty base can be commuted with an inversely proportional change in the royalty rate: 5 percent of $1,000 = 500 percent of $10 = $50. If the royalty *base* is divided by 100, then the royalty *rate* can be multiplied by 100 and the total revenue made by the SEP owner will remain constant. In algebraic terms, $1 = $1. As long as parties can adjust the royalty *rate*, changes to the royalty *base* are neutral.[41]

This result is an application of the royalty allocation neutrality result of Layne-Farrar et al.[42] These authors show that licensing at the upstream (component) or at the downstream (handset) level is irrelevant for welfare and that only the sum of the royalty charged matters. This neutrality result is constructed assuming efficient bargaining and per-unit royalties both at the upstream and the downstream levels.

In the following sections, we show that introducing behavioral bias in royalty negotiation does not alter the neutrality of the royalty revenue multiplication.

B. Behavioral Economics and Anchoring Effects

Behavioral economics study the impact of cognitive, psychological, and emotional factors on individuals' decision-making processes. The findings of behavioral economics challenge mainstream rational choice theory. Behavioral

[40] The price of a chipset processing unit is usually between $16 to $18 but baseband processors can be sold for between $30 and $40. Woyke, E. 2014. *The Smartphone: Anatomy of an Industry*. New-York: The New Press.

[41] The choice of royalty base is not neutral when it changes the way firms are competing on the downstream market. See Kamien and Tauman, *supra* note 9 and San Martin and Samacho, Llobet and Padilla *supra* note 10 for models where the choice a royalty basis impact competition on the market.

[42] Layne-Farrar, A., Llobet, G. and Padilla, J. 2014. Patent Licensing in Vertically Disaggregated Industries: The Royalty Allocation Neutrality Principle, *Digiworld Economic Journal*, 95:61–84.

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economics shows that economic agents' decisions are based on heuristics.[43] As a result, their behavior often deviates from that of perfectly rational agents. Behavioral economics research in turn documents the determinants of behavioral biases.

Against this backdrop, behavioral economics show that when the value of a good or service is difficult to assess, economic agents tend to construct valuation preferences in regard of certain starting points, framing contexts, and value signals. In this regard, a particularly strong heuristic, identified by Tversky and Kahneman, is known as the *anchoring effect*.[44] The idea is that economic agents make estimates by starting from an initial value, which they then adjust to yield the final answer. Behavioral economics in turn show that adjustments are systematically insufficient because they are biased toward the initial value that is presented to them.[45] Hence the term anchoring. In Tversky and Kanheman's the seminal experiment, participants spun a wheel of fortune and received a percentage number, 10 percent or 65 percent. They were then asked to estimate the percentage of African countries that participated in the United Nations. Those presented with a low starting value (10 percent) reported a median 25 percent and those with a higher stating value (65 percent) reported a median 45 percent.

The anchoring effect suggests that the estimated value of an SEP-protected technology may be assessed differently if the initial reference for the *royalty base* is a $1,000 handset or a $10 chipset. Exposed to a $1,000 end product, the estimated value is likely to be high; exposed to a $10 component, it is likely to be low. And, the anchoring effect is likely to be more pronounced when there are huge differences between the two royalty bases. Put differently, the use of a low price anchor in the *factor* royalty base is likely to depress the *product* of the multiplication while a high price anchor in the *factor* royalty base is likely to boost the product of the multiplication. In our example, if the handset is the anchor, the technology valuation will be $50. But if the parties start to discuss with the chipset in mind, they may consider a lower valuation, for example, $40, 30, 20, 10, 5 or even 1. A change in the royalty base therefore affects the valuation of the technology by both parties in a royalty negotiation between an SEP owner and a prospective licensee.

[43] This term denotes intuitive, rapid, automatic and often simple rules of thumb. Furnham, A. and Chu Boo, H. 2011. A Literature Review of the Anchoring Effect, *The Journal of Socio-Economics*, 40:35–42.

[44] Tversky, A. and Kahneman, D. 1974. Judgment under Uncertainty: Heuristics and Biases, *Science*, 185:1124–1131.

[45] Ariely *et al*. show that consumers' evaluation of goods is arbitrary even for experience goods in a set-up with full information. However, once the initial estimate has been made, subsequent variations are coherent, consistent for instance with the *law of demand*. They refer to the concept of *coherent-arbitrariness* to represent this behavior. Ariely, D., Lowenstein, G., and Prelec, D. 2003. Coherent Arbirariness: Stable Demand Curves without Stable Preferences, *The Quarterly Journal of Economics*, 118:73–104.

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C. Anchoring Effects: Application to SEP Bargaining

Let us now look at the consequences of anchoring effects on licensing discussions between SEP owners and implementers. A useful and realistic way to represent a hypothetical negotiation has been proposed by Sidak, who offers to frame it as a negotiation within a well-specified *bargaining range*.[46] Because parties to a negotiation have distinct valuations in mind, the bargaining range represents the zone of acceptable technology valuations, within which a mutually profitable licensing agreement between the SEP owner and the implementer can be reached. The upper bound of the bargaining range represents the maximum valuation, at which the implementer is willing to buy (WTB). The lower bound represents the lowest valuation at which the SEP owner is willing to sell (WTS) the technology. Negotiating parties have to evaluate their willingness to buy and to sell. The WTB is a function of the costs incurred to manufacture a compliant product, and of the opportunity costs of redesigning a noninfringing product. The WTS is essentially a function of the opportunity costs of nontransacting. When evaluating their willingness to buy and to sell, parties are often subject to behavioral bias.[47]

If the bargaining range is nonempty, that is, if the buyer's WTB is higher than the seller's WTS, there is a variety of mutually profitable agreements. The exact valuation point at which the parties settle is a function of the parties' bargaining power.

In practice, valuations are exchanged in royalty terms. When the parties agree on a given royalty level, the buyer's surplus is the difference between its WTB and the royalty level, and the seller's surplus is the difference between the royalty level and its WTS. The *total surplus* (or welfare) is the sum of the buyer's and the seller's surplus, which is the difference between the WTB and the WTS. Figure 1 illustrates the bargaining range over which the parties negotiate a licensing agreement, the licensing point, and the surpluses assuming that the bargaining range is nonempty.

Returning to our example, consider that the parties negotiate a licensing agreement taking the EMV as the base. Suppose that the SEP implementer WTB is $60 and that the SEP owner WTS is $40.

Consider now the same hypothesis, with the tweak that the SSPPU is the base. If the parties are subject to anchoring effect, this change in initial conditions produces lower valuations for the technology on both bounds. Anchoring effects reduce the implementer WTB to $40 and the SEP owner WTS to $20. An important finding of the behavioral economics literature is indeed that anchoring affects both buying and selling decisions, in our example

[46] Sidak *supra* note 8.

[47] Simonson, I. and Drolet, A. 2004. Anchoring Effects on Consumers' Willingness-to-pay and Willingness-to-accept, *Journal of Consumer Research*, 31:681–690.

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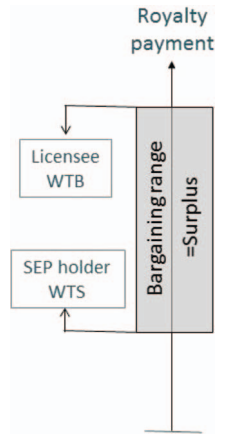

Figure 1. The bargaining range.

and for simplicity in a symmetric way. [48] This leads to a downward shift of the bargaining range. Figure 2 illustrates this change. Such a shift in valuations has an impact on the negotiated royalty level (assuming there is no change in the bargaining power of the parties in the negotiation). If, for instance, the negotiated royalty level is the median point between the upper and lower bounds—as would be the case in a Nash bargaining with equal bargaining power—then SSPPU will inevitably shift down the royalty point to reflect the lower technology valuations, in our example from $50 to $30.

However, the change in the royalty level illustrated in Figure (2) is unproblematic from a welfare standpoint. As can be seen, the bargaining range shifts downward but the total surplus remains the same under EMV and SSPPU. This means that there is an equal amount of economic surplus ($20) to share between the parties in both settings, though the technology is nominally valued at lower levels in SSPPU. As long as either apportionment method generates an equal amount of surplus, there is no reason to favor one over the other from an economic standpoint. Hence, anchoring effects are not in themselves a concern and from a distributional point of view, the change of royalty base is neutral and $1 is $1. Moreover, in efficiency terms, there is no room for worry as long as the rule was in place at the time of entry in the industry by both

[48] Buyers' and sellers' estimations are usually affected by different behavioral bias and the behavioral economic literature has shown that buyers and sellers have an asymmetric valuation estimate. Endowment effect, status quo bias, and loss aversion explain these asymmetric patterns. Thaler, R. 1980. Toward a Positive Theory of Consumer Choice, *Journal of Economic Behavior and Organization*, 1:39–60. Kahneman, D., Knetsch, J.L., and Thaler, R.H. 1991. The Endowment Effect, Loss Aversion, and Status Quo Bias, *Journal of Economic Perspectives*, 193–206.

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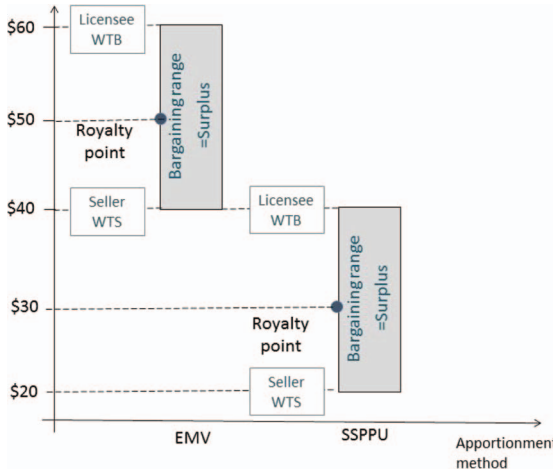

Figure 2. Impact of the apportionment method on the bargaining range.

parties. Pricing effects will have been anticipated and internalized by industry participants when they made the decision to invest.[49]

Moreover, the anchoring literature provides additional insights on the likely impact of anchors on royalty negotiations. First, the behavioral economy literature recognizes that "*greater cognitive skills decrease anchoring effects.*"[50] Second, several studies have suggested that anchoring effects can be—at least partially—corrected in business negotiations, for instance when parties concentrate on eliciting the other's reservation prices.[51] These observations could mitigate the importance of the anchoring effect in multiple digit licensing contract negotiations between expert SEP owners and implementers.

That said, even if SEP negotiators may not be trapped by low initial values and may overcome the behavioral bias created by the selection of SSPPU as the licensing basis, there is another reason why SSPPU exerts anchoring effects on expert negotiations between SEP owners and implementers. Licensing negotiations take place in the shadow of litigation. If the discussions break down, the best alternative to a negotiated agreement consists of having an impartial spectator—a judge, arbitrator or agency—setting the estimated value of the technology. Thus, even if parties can escape behavioral traps, anchoring

[49] As long as this valuation system was anticipated and applicable before investments in technology and costs being incurred by market players. This is an important qualification. Our finding may not hold if SSPPU is transitionally introduced in a market, when economic agents have based their investments and costs decisions on a distinct valuation system.

[50] Bergman, O. Ellingsen, T., Johannesson, M., and Svensson, C. 2010. Anchoring and Cognitive Ability, *Economics Letters*, 107:66–68.

[51] Galinsky, A. and Mussweiler, T. 2001. First Offers as Anchors: the Role of Perspective Taking and Negotiator Focus. *Journal of Personality and Social Psychology*, 81:657–669.

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effects will influence the computation of damages in courts if judges apply SSPPU as the basis for fixing royalties.

IV. SSPPU+, REVENUE CAP, AND ECONOMIC SURPLUS REDISTRIBUTION

In an industry subject to SSPPU, there is a lower valuation for the technology that can be observed in the smaller nominal valuations of the upper and lower bounds of the bargaining range. Yet, this is neutral in terms of economic surplus. As seen above in our examples, the zone covered by the bargaining range is the same, and the total surplus shared between the parties remains equal. However, when component licensing is applied on top of SSPPU—thus moving to SSPPU+—there is an additional effect on the distribution of the surplus between parties. Due to other negotiation constraints (A), SSPPU+ collapses the upper bound of the bargaining range and thus creates a revenue cap (B). Given this cap, SEP intensive technologies will be sold at a uniform price across industries, failing to internalize complementarities (C). As a consequence, the choice of a royalty basis is no longer neutral and $1 is no longer $1.

A. Negotiation Constraints

When SSPPU+ is the rule, the bargaining range is not as large as under end-user device licensing or as under SSPPU with end-user device licensing. Indeed, when component licensing and SSPPU operate in conjunction, the upper bound of the bargaining range is lower. This is due to yet another set of behavioral and legal constraints.

1. Behavioral constraints

So-called "*unit effects*," a variant of the above-mentioned anchoring effect, limit the ability to adjust the royalty level in percentage terms. The concept of unit effects originates in behavioral economics. It explains that economic agents focus more on the number than on the unit. Unit effects predict that a 500 percent royalty rate will be perceived as "*high*" while a 5 percent royalty rate will be perceived as "*small*." Due to unit effects, variations of several percentage points from industry practice may be tolerated. But larger changes to the royalty rate factor will not be possible.

Let us apply this to our hypothetical example. In both the EMV and SSPPU scenarios where WTB and WTS are respectively $60–$40 to $40–$20,[52] the application of SSPPU+ (that is component licensing) to a $10

[52] Unit effects are not specific to SSPPU and can also exist with EMV, as long as component licensing is applicable.

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chipset produces a royalty rate specification of 500 percent and 300 percent respectively, whereas end-user licensing produces a royalty rate specification of 5 percent and 3 percent, respectively.

In practice, unit effects limit the possibility to impose high nominal royalty rate. This rigidity is likely to be particularly compounded in sectors where components sell for a low price.[53] But, if a change in the royalty basis cannot be accompanied by an inversely proportional change in the royalty rate, the multiplication is no longer neutral.

As far as real case applications are concerned, unit effects have been encountered in *Cornell v HP*. Here the jury agreed on a royalty rate of 0.8 percent. The judge then proceeded to determine the SSPPU. Interestingly, the judge changed the SSPPU from the CPU brick to the processor, yet kept the royalty rate constant at 0.8 percent, leading to a change in royalty revenue from $23 to $6.6 bn. This example, described in greater details by Putnam and Williams[54], illustrates the fact that the royalty basis and the royalty rate are not determined simultaneously, a condition for the neutrality of multiplication. Rather the court decided first on the royalty rate and later adjusted the royalty basis to the smallest component's turnover without modifying the royalty rate.

2. *Antitrust constraints*

Antitrust laws may prevent the formulation of high nominal royalty levels when component licensing is applied, all the more so when the royalty level is specified as a percentage rate. This influence operates through the application of antitrust doctrines alone (typically in proceedings before antitrust agencies) or in conjunction with doctrines from other areas of the legal system including contract and patent law (typically, in patent infringement and damages litigation). We discuss them hereafter.

[53] Some authors refer to an informal 25 percent rule that governs intellectual property transactions. This rule sets that royalties represent one-fourth of the profits made by the product that embodies the patented technology. Goldscheider, R., Jarosz, J., and Mulhern, C. 2002. Use of The 25 Per Cent Rule in Valuing IP, *Les Nouvelles*, MIHR (USA), 123–133; Razgaitis, R. 2007. Pricing the Intellectual Property of Early-Stage Technologies: A Primer of Basic Valuation Tools and Considerations. In *Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices*, Krattiger, A. *et al*. (eds) Vols 1 and 2, pp. 813–860. See also, Courtois, Y., McPhee, D., Rerolle, J.F. Profitability and Royalty rates across Industries: Some Preliminary Evidence (*KPMG*, 2012) < https://assets.kpmg.com/content/dam/kpmg/pdf/2015/09/gvi-profitability.pdf> accessed 13 May 2019. In the United States, the Court of Appeals for the Federal Circuit's ruling in *Uniloc v. Microsoft*, banned the use of the 25 percent rule in 2011. No damages expert has been able to rely on that rule since then.

[54] Putnam and Williams, *supra* note 7.

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First, in all competition law jurisdictions where a system of control of excessive prices exists, such as the EU, China, or Korea, high nominal royalty rates may attract antitrust exposure. For the purposes of this subsection, let us focus on EU antitrust law given its significant experience in the field (as compared, for example, to younger Asian antitrust regimes). EU antitrust rules prohibit dominant firms from imposing "*unfair purchase or selling prices or other unfair trading conditions*." The law does not define at what level a price can be deemed unfair. In *United Brands*, the EU courts referred to a price that "*has no reasonable relation to the economic value of the product supplied*."[55] In practice, agencies and courts have consistently deemed unfair prices, which exceed costs by more than 100 percent the value of the product/service in question.[56] At the same time, in its latest pronouncement on the issue in 2017, the Court said that an unreasonable price is characterized when the difference between price and costs is "*significant*," "*persist for a certain length of time*," and is not "*temporary or episodic*."[57] In the area of cartel law, antitrust authorities go as far as to consider that a 25 percent overcharge on markets denotes a threshold value for the harm caused by shared monopoly power.

Second, rigidities may also bear on the royalty rate factor through the application of antitrust essential facilities rules or contractual duty to deals. Essential facilities doctrines exist in many antitrust jurisdictions other than the United States. In the United States, though, a similar effect may be achieved through contract law, when FRAND terms are interpreted as requiring patent owners to their SEPs to modem chip suppliers.[58]

In so far as non-U.S. jurisdictions are concerned, the implication of such duties is to trigger the application of substantial conduct remedies on firms, in the form of duties to supply in general, and of duties to license in the particular case of IP owners. Almost invariably, antitrust jurisdictions that decide to impose a duty to license upon dominant firms also force them to transact on

[55] See Judgment of the Court of 14 February 1978 in *United Brands v Commission* [1978], 27/76, EU:C:1978:22, §250.

[56] See Hordijk, E.P. 2002. Excessive Pricing under EC Competition Law: An Update in the Light of 'Dutch Developments'. In *2001 Fordham Corporate Law Institute*, Hawk, B.E. (ed.) Juris Legal Information (USA), pp. 463–496. For instance, in *ITT/Promedia*, the EU antitrust agency was concerned that the price charged by the Belgian incumbent telephony operator to publisher of telephone directories were almost 100 percent above the costs it incurred for the collection, treatment, and provision of data to the directories publishers. Under such prohibitions, any royalty rate that represents one or more times the value of the component could be deemed unlawful. And in *British Leyland*, the European Court of Justice (ECJ) undertook a comparison between the historical prices of the dominant firm and the prices it charged in the past. The Court found that the fees had increased BY 600 percent during the relevant period, and considered as a result that they were abusive.

[57] Case 117/16 AKKA/LAA [2017] ECLI:EU:C:2017:689.

[58] In *FTC v Qualcomm*, Judge Lucy Koh held that the TIA and ATIS IPR policies both required Qualcomm to license its SEPs to modem chip suppliers, including to competitors. *FTC v Qualcomm* [2018], Order Granting FTC's Motion for Partial Summary Judgment, 06 November 2018, Case No. 17-CV-00220-LHK.

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reasonable terms. If we conjecture that a dominant SEP owner may be subject to an antitrust duty to license its technology, then we must accept that antitrust agencies will scrutinize that the royalty basis[59] and the royalty rates charged for the technology are not set at a level that *de facto* prevents the conclusion of a licensing agreement. This is what happened in the *Microsoft* antitrust case in Europe.[60] Having imposed a duty to license interoperability information on Microsoft, the EU Commission entertained complex discussions with Microsoft to establish "*reasonable and nondiscriminatory terms*." The case ended in Court, and a large fine was inflicted on Microsoft for failure to specify FRAND rates.

Third, in the specific area of FRAND-pledged SEPs, various jurisdictions now refer to industry practice as the reference for assessing whether a proposed FRAND rate is antitrust compliant. In *Huaweï v ZTE*, the Court of Justice of the EU said that FRAND discussions ought to comply with "*recognized commercial practices in the field*."[61] The general effect of such judicial doctrines is to transform informal industry practice into legally enforceable principles. While this is not a problem in itself, its particular implication is that admitted royalty rate may become the norm applied by courts, irrespective of royalty basis. The U.S. approach to FRAND puts emphasis on royalty rate levels, and the evidentiary rules suggest to use comparable licenses to determine the FRAND royalty rate.[62] But comparable licenses may not be a good indicator of the patented feature's value. In the case of patent negotiation, a foreseeable application is the 25 percent informal industry norm. Under this rule (of thumb), an IP owner can legitimately receive a royalty rate equivalent to 25 percent of the expected revenue for the application that practices the IP at issue. Significant deviations from industry practice may be conducive to antitrust liability.

Fourth, a convoluted way to prevent SEP owners to extract royalties from the end product involves the judicial application of the antitrust rules together with the patent specific doctrine of "*exhaustion*." This could apply in the specific scenario where an SEP owner conditions the granting of a license to a chip maker to an obligation to sell only to device makers who have themselves

[59] "*Viewed through the lens of the entire market value rule, a refusal to license at the chip and component level, as part of an overall strategy of price discrimination, is merely a disguised attempt by the patentee to obtain a patent royalty in excess of what the patent, considered by itself, is worth. Thus, the entire market value rule, and the principle of the smallest saleable unit, will tend to undermine the legitimacy of any strategy of refusing to license at the chip and component level*." Belgum, K.D. 2014. The Next Battle Over FRAND: The Definition of FRAND Terms and Multi-Level Licensing, *Journal of the Intellectual Property Law* 39.

[60] Judgment of the General Court of 27 June 2012 in *Microsoft v Commission* [2012], T-167/08, EU:T:2012:323.

[61] Judgment of the Court of 16 July 2015 in *Huawei Technologies v ZTE* [2015], C-170/13, EU:C:2015:477, §65.

[62] Baron, J. Pentheroudakis, C., and Thumm, N. 2016. FRAND Licensing in Theory and in Practice: Proposal for a Common Framework, *CPI Antitrust Chronicle*, 1:1–8.

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taken a license. This practice, known as "*multi-level*" licensing, entitles SEP owners to price discriminate, by charging distinct royalties at different levels in the value chain. An SSPPU+ spirited judicial fact finder could come to the realization that multi-level licensing undermines the whole point of seeking to reduce the royalty burden in SEP-intense industries. Judicial fact finders may thus attempt to limit multi-level licensing, by considering that contractual terms conditioning the granting of a license to resale restrictions are either abusive for the patent infringer or form part of an anticompetitive agreement amenable to antitrust liability, because they negate the "*exhaustion*" principle whereby "*one who purchases from a patentee or licensee in an authorized sale obtains the patented product free and clear of patent rights*."[63]

Note that none of the above doctrines has yet been specifically tested against SEP owners and that their positive validity remains uncertain. This notwithstanding, the flexibility of antitrust laws is such that there is a nontrivial chance that an antitrust decision maker or a judicial fact finder could attempt to experiment one or all of such novel interpretations.

B. Revenue Cap and Economic Surplus Redistribution

The previous section shows that behavioral biases and antitrust rules prevent the specification of any royalty *level* in licensing negotiations. There is therefore a *de facto* price cap on the royalty rate. What is more interesting, however, is that the joint operation of this rate-cap and of component licensing under SSPPU+ implies that there is also a revenue cap on the total royalty payment for the SEP owner.

Let us denote by $r^{\max}$, the highest admissible nominal royalty rate, by C^k the cost (or value) of the SEP-protected component k, which is used as the royalty base (as proposed under SSPPU+). The total revenue for the SEP owner is at most:

$$R^{\max} = r^{\max} x\, C^k. \tag{2}$$

The revenue cap means that the SEP owner cannot expect to receive more than R^{max}, should negotiation break down, and the licensing rate be fixed by a court, arbitration tribunal, or antitrust agency. The revenue cap shrinks the zone covered by the bargaining range in royalty negotiations. The story depicted in Figure 2 is therefore incomplete. If $R^{\max} < WTB$, the upper bound of the bargaining range is fixed by the revenue cap. Indeed, a prospective licensee will never agree to pay a higher price than the default price, set by a court, arbitration tribunal, or antitrust agency. Figure 3 depicts the bargaining range under the SSPPU+ with the upper bound corresponding to $R^{\max}$, considering that the bargaining range is nonempty. As it is shown on the figure, with a revenue cap, the surplus and the bargaining range do no longer coincide.

[63] Belgun, *supra* note 58.

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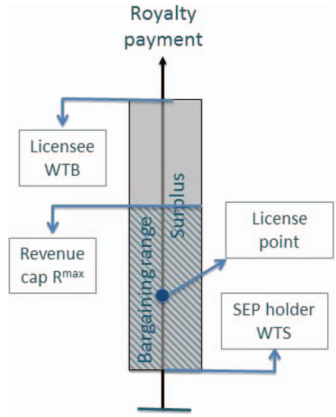

Figure 3. Impact of a revenue cap on the bargaining range.

The surplus is the difference between the *WTB* and the *WTS*, the bargaining range the difference between R^{max} and *WTS*. This means that the parties no longer bargain to share the entire surplus. The imposition of such a revenue cap has therefore important redistributive effects.

1. Redistribution to implementers

The first redistributive effect consists in a transfer of surplus to SEP implementers. As can be seen in Figure 3, the bargaining range is a subset of the economic surplus. Due to the above-mentioned negotiation constraints, royalty terms in the higher region of the surplus are unavailable. Put differently, the addition of component licensing in SSPPU+ acts as a *haircut* on the bargaining range.

The consequences of this haircut on the bargaining process are easy to infer. The parties will negotiate a royalty term within the bargaining range. A downward shift in the upper bound of the bargaining range will decrease the royalty term point. But the story is different from Figure 2 because in this case, the distribution of the surplus between the SEP owner and the implementer will be different. Assuming total surplus and bargaining power is unchanged, the buyer's share of surplus will increase at the expense of the seller's share. The buyer will receive a larger share of surplus since the upper bound of the bargaining range is below its WTB. The parties will negotiate a royalty term within the bargaining range but part of the surplus is already in the pocket of the licensee, should an agreement be reached. In other words, when negotiation takes place under SSPPU+, what is to be shared is not the total surplus (*WTB*-*WTS*) but the bargaining range (R^{max}-*WTS*). Unless the SEP owner enjoys greater bargaining power, the distribution of surplus under SSPPU+ is biased toward implementers.

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According to the revenue cap formula in equation (2), the highest possible revenue is a function of the nominal royalty term, which is capped, and the royalty basis, that is, the smallest component cost in the SSPPU. This has another important consequence. A technology that is embodied in a chipset that costs just a few dollars to manufacture will generate a low unit revenue for its owner. Of course, one may counterclaim that the cost of the chipset should not be confused with its value. But the practice of licensing negotiations may lead to the use of the chipset cost as a proxy because it will often be the only available metric to discuss the value added to the component.[64] Moreover, antitrust law often dictates to look at cost as a proxy for economic value. In *United Brands*, the EU courts said that the economic value of a product could be assessed by looking at its cost of production.[65] As a result of this, the upper bound of the bargaining range will often be cost-based and not linked to the added value of the SEP protect technology. As the cost and the value are two different things, connecting the revenue to the cost potentially creates a huge gap between the SEP owner's revenue and the technology value.

2. *Redistribution among SEP owners*

The biased distribution of surplus may also occur among SEP owners, due to the specific nature of the standardization process itself. SSOs combine technologies, owned by multiple firms, to address a given technical problem. In economic terms, the technologies that support a standard are complements. They have no or lower value when implemented on a standalone basis but yield high or higher value when combined with other technologies. Against this backdrop, SSPPU+ rule does not only redistribute value from SEP owners to implementers but also among SEP owners. This can again be understood with a stylized example. Consider two complementary technologies A and B that are selected to form a standard AB. The standard generates a $20 surplus. Suppose that this surplus is shared under EMV licensing as followed: a $10 surplus for the component implementer and a $10 surplus for the SEP owners, each getting a $5 surplus. And, assume that component makers who implement the technology costs are C^A = $1 and C^B = $2. When the royalty basis is the component cost, SEP owner A must apply a 500 percent royalty rate and SEP owner B a 250 percent royalty rate to collect the same surplus. Clearly, the same revenue sharing cannot be implemented with SSPPU+ and SEP owners will collect lower royalties. Consequently, the implementer collects a larger share of the surplus.

[64] As Kappos and Michell, *supra* note 28: "*It is even argued that in an infringement case against a multi-component product, the SSPPU concept implies that the royalty base must be derived not from the value the invention contributes to the end product, but from the cost to the infringer of one or more components it purchased from its suppliers.*"

[65] United Brands, *supra* note 54.

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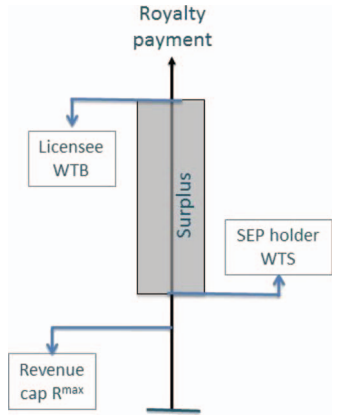

Figure 4. Impossibility of trade.

Now suppose that C^A = \$1 but C^B = \$7. In this case, by applying a 100 percent royalty rate, SEP owners A and B will collect a surplus of respectively \$1 and \$7 while the implementer has a surplus of \$12. In such setting, there is not only a transfer of surplus from SEP owners to implementers, but there is also a redistribution from SEP owners that address low-cost implementations to SEP owners that sell high costs components or inefficient ones. While the revenue cap is strong for SEPs with low-cost implementations, it is much less constraining for SEPs with high costs implementations, because the latter enjoy a larger royalty base on which to collect more value in the negotiation process. Likewise, SSPPU+ is likely to favor vertically integrated component manufacturers.[66]

3. *Impossibility of trade*

At a certain order of magnitude, SSPPU+ shrinks the bargaining range to the point where it becomes empty (Figure 4). Consider a situation where the upper bound of the bargaining range R^{max} falls below the seller's *WTS*. Then, there is no royalty term within the bargaining range that can return a positive surplus to the seller. This situation occurs despite the fact that there would be a positive surplus from trade. In that circumstance, we face the impossibility for parties of agreeing on a mutually profitable trade.[67]

Let us revert to our initial example. Assume that SSPPU+ lays down an implicit cap a 100 percent cap on the royalty rate. If the component cost is \$10, the highest revenue for the seller is 100 percent x \$10 = \$10. This value represents the upper bound of the bargaining range. Yet, the bargaining range under SSPPU+ is empty because the seller's WTS is equal to \$30.

[66] Putnam and William, *supra* note 7.
[67] Sidak *supra* note 8 says that there is no voluntary agreement in reach.

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The zone of possible agreement between the SEP owner and the implementer decreases. Therefore, a higher likelihood of early litigation exists under SSPPU+ than under SSPPU or EMV. To be more concrete, under SSPPU+, there is a nontrivial possibility that the SEP owner initial FRAND offer and the SEP implementer initial counter-offer will be worlds apart. As a result, parties will more promptly bring their different before courts. Interestingly, the paradox that ensues is that, while SSPPU+ was supposed to solve perceived problems, courts will be increasingly faced with extreme demands on both sides. This, in turn, will create a reinforcing feedback loop that there is a market failure that needs to be solved.

C. Complementary Technologies and Uniform Pricing

Often technologies spread among multiple application sectors, creating value and complementarities across industries. Technologies like Wi-Fi or 5G display important vertical and horizontal externalities. With the IoT, a whole set of objects (physical objects, home appliances, vehicles) will be equipped with communications chips and sensors. However, the value of technology will be different from one sector to another. The same communication technology will be used for automated vehicles and for monitoring the content of a fridge or the room temperature. Clearly enough, the benefits of a communicating fridge are far below those of an automated car.

If we follow the proposition that technology prices should reflect externalities, then this implies that royalty revenue for general purpose technologies (GPT) should vary across application sectors, product uses and implementing processes. In other words, if a technology is used in two applications sectors, the price should vary to reflect the different externalities created in the two sectors. With this background, suppose that a standard A embodied in a component with cost C^A = \$5. Standard A can be used in two sectors: sector B where it has a value of \$20 and sector C where its value is equal to \$3. Quite logically, royalty negotiations should lead to a lower payment for the technology in sector C where it has less value than in sector B. Indeed, implementers in sectors B and C will not pay more than the technology added value and in that sense, the values of \$20 and \$3 represent the willingness to buy of sectors B and C. However, we have argued that the SSPPU+ imposes a revenue cap on royalty revenue and that this revenue cap is cost-oriented, that is, linked to the component value C^A = \$5. Therefore, in both sectors, the bargaining range will have the same upper bound corresponding to the revenue cap R^{max}. In such a situation, without substantial differences in the bargaining power of the parties between the two sectors, it is likely that the SSPPU+ leads to *uniform pricing* of the technology. Uniform pricing means that the extra benefit of the standardized technology will not be collected by the developers but by the implementers in sectors B and C. In other words, by imposing the same basis for computing royalties in sectors B and C, and by

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limiting the nominal royalty rate, the SSPPU+ fails to take into account the externalities and complementarities created by a technology, to the benefit of the implementers and at the expense of the technology developers.

V. GENERAL PURPOSE TECHNOLOGIES

To close, this paper formulates the intuition that the indiscriminate application of SSPPU+ to all standards including those with sizeable externalities may disconnect the royalty revenue from the added value brought by the technology. In particular, there are specific concerns related to GPT that need to be taken into account. This is the issue that we now explore.

GPTs are technologies that yield substantial externalities across multiple applications sectors.[68] Textbook examples include the steam engine, electrification, and the Internet. GPTs are primarily studied in macroeconomics, and in particular in the field of growth theory.[69]

GPTs have three main attributes: first, they enjoy "*general applicability*" in the sense that they "*perform a generic function that is vital to the functioning of a large number of using products*" and processes. Second, they display "*technological dynamism*," that is, that the efficiency of the generic technology improves continuously, which drives further adoption in novel applications sectors. Third, GPTs benefit from "*innovational complementarities*," in the sense that improvements in the GPT make it more profitable for applications developers to innovate, which in turn increases demand for, and investments in, the GPT itself.[70]

There is no consensus on the precise definition of a GPT but most papers frame the benefits of GPTs in terms of externalities, both vertical (between the GPT and an application sector) and horizontal (across applications sectors).[71] In the literature, externalities do not diffuse instantly either but instead are subject to significant time gaps and sequentiality.

The literature distinguishes two phases of growth for GPT.[72] There is a first growth phase in which the technology diffuses. Growth is then driven by the

[68] Bresnahan, T. and Trajtenberg, M. 1995. General Purpose Technologies: Engines of Growth, *Journal of Econometrics*, 65:83–108.

[69] Crafts, N. 2004. Steam as a General Purpose Technology: A Growth Accounting Perspective, *The Economic Journal*, 114:338–351.

[70] See Rosenberg, N. and Trajtenberg, M. 2004. A General-Purpose Technology at Work: The Corliss Steam Engine in the Late-Nineteenth-Century United States, *The Journal of Economic History*, 64:61–99. Others decompose those features in four characteristics. See Lipsey, R.G., Carlaw, K.I., and Bekar, C.T. 2005. *Economic Transformations: General Purpose Technologies and Long-Term Economic Growth*. Oxford: Oxford University Press.

[71] Bresnahan and Trajtenberg, *supra* note 67.

[72] Helpman, E. and Trajtenberg, M. 1994. A Time to Sow and a Time to Reap: Growth Based on General Purpose Technologies. No. w4854. *National Bureau of Economic Research*; More generally, on the importance of time gaps and sequences in GPTs, see Basu, S. and Fernald, J. 2007. Information and Communications Technology as a General Purpose Technology: Evidence from US Industry Data, *German Economic Review*, 82:146–173.

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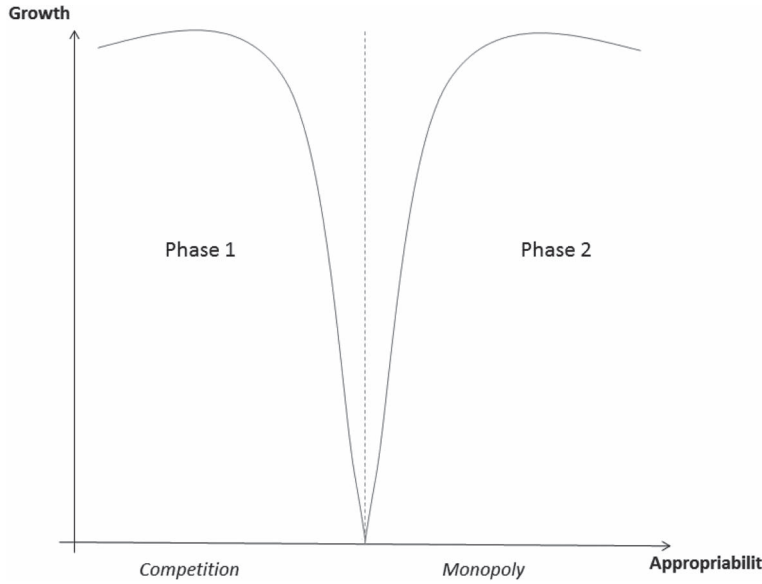

Figure 5. GPT timing and optimal appropriability policy.

adoption of the technology. Growth in the second phase is driven by investments in complementary technologies and the diffusion of the technology in all sectors of the economy. We show this in Figure (5), which distinguishes both phases.

This feature gives rise to "*imperfect appropriability*." In turn, the literature considers that policy, governance, and institutional measures can increase the appropriability of investments in GPTs, and promote innovation. Yet, policy measures may also run counter to the diffusion of GPTs, in particular if they lower the returns to complementary investments made by users.[73] Which of both effects dominates the other, however, is unclear. Bresnahan and Trajtenberg note that "*pricing rules [will imply] that neither side will have sufficient incentives to innovate*".[74] Yet, several studies call our attention to the "*time horizon*."[75] As explained earlier, the conventional GPT model describes a cycle with a first phase of lower output, and a second phase of growth. A growth-oriented policy that stands at the beginning of the first phase may want to minimize its length. In turn, this suggests policy measures aiming at

[73] Bresnahan and Tratjenberg, *supra* note 67.
[74] *Id*.
[75] Helpman and Trajtenberg, *supra* note 71; " the government's optimal strategy to spur innovation is drastically different when an emerging technology has the character of a GPT than when it is an incremental technology. The level of appropriability of technologies complementary to the core innovation should be lower in the former case than in the latter on " Youtie, J., Iacopetta, M., and Graham, S. 2008. Assessing the Nature of Nanotechnology: Can we Uncover an Emerging General Purpose Technology? *The Journal of Technology Transfer*, 33:315–329.

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fostering competition in the components sector. By contrast, at the beginning of a second phase, an acceleration of growth should lead to the adoption of measures "*increasing appropriability*."[76] From an operational standpoint, Helpman and Trajtenberg, briefly and without any more detail, mention antitrust and intellectual property as possible instruments to deploy or discard in both phases.

In our view, a number of limiting principles emerge from the combination of the abovementioned general scholarship on GPTs and our specific research on SSPPU+. *First*, there seems to be considerable uncertainty in the ability to identify GPTs both prospectively and retrospectively. From a policy standpoint, the risk of error in misdiagnosing a GPT should impart caution in the calibration of appropriability or competition-spirited remedies at early stages of technology development. This is why measures like SSPPU+ (or the EMV) that indiscriminately apply to all licensing discussions *ex ante* should be avoided, and only be envisioned as one possible option in *ex post* patent damages litigation, where the general purpose character of technology can be better verified.

Second, if policymakers are confident in their GPT diagnosis, then the calibration of appropriability versus competition-spirited remedies should be a function of the maturity of the technology under consideration. In other words, competition-spirited remedies (like antitrust initiatives) should be deployed at early stages of GPT introduction, and appropriability-driven measures (like strong intellectual property protection) should be promoted when complementary applications, components, and inputs have been developed.

If trying to apply this to standards, and in particular to wireless communications standards where SSPPU+ is in discussion, practical difficulties appear readily. While it may be tempting to view each generation of standards (2G, 3G, 4G, and 5G) as a distinct GPT, it is equally possible to consider the initial wireless technology as the GPT. Depending on the answer to bring to this issue, the exact location of the policymaker on the time horizon changes (horizontal axis). In the former hypothesis—each generation of wireless communications standards—is a GPT, then competition-spirited remedies (like SSPPU+) are appropriate. In the latter hypothesis—early wireless communications standards were the GPT—then appropriability-friendly measures seem warranted. This question, which is largely empirical, however, is rendered even more complicated by the introduction of evolutionary versions of wireless standards, like EDGE (2,5G) or LTE (3,5G).

However, based on our review of the literature, it is doubtful that each wireless standard deserves to be characterized as a stand-alone GPT. No economic paper seems to consider incremental improvements in the performance of the steam engine, electrification, and Internet connectivity as GPTs of their own. Instead, such improvements are often used as proof of concept, to characterize

[76] Helpman and Trajtenberg, *supra* note 71.

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the base, generic technology as the GPT. We see no obvious reason to treat wireless communications differently.

VI. CONCLUSION

This paper has explored the effects of a widespread generalization of SSPPU+ pricing from both distributional and efficiency perspectives. It shows how a pricing rule that only changes the royalty *base* without controlling for the royalty *rate* nevertheless imposes a revenue cap on standardized technologies and distorts the distribution of revenue in ways adverse to technology developers. Therefore, the choice of a royalty basis is not neutral and $1 is not $1. And, as we have said, redistribution is not only a matter of rent sharing. Redistribution may alter the incentives to participate in the standardization process and promote alternative business models like proprietary standards, vertical integration. We discuss some possible consequences to conclude our paper.

First, it cannot be excluded that a licensing firm may switch to alternative valuation models, like fixed fee licensing. Following Kamien and Tauman[77], the literature shows that the valuation method impacts both firms on the downstream market by modifying the dynamics of competition as well as firms on the upstream market by changing their incentives to innovate. The optimal valuation method depends on the nature of competition (price v quantity), the type of innovation (drastic v minor), and the participation of the innovator in the downstream market.[78]

Second, SSPPU+ could have an even more drastic impact on firms' strategic decisions. In a classic Coasian trade-off between markets and hierarchies, firms exposed to costly transactions with third parties may substitute vertical integration to licensing negotiation. In particular, SEP developers may resort to *forward* (downstream) integration in the component segment, to keep their ability to license at the end-user level. Several contemporary high-level merger transactions could be explained on that ground (Qualcomm's attempt to acquire NXP and Intel acquisition of Mobileye). Interestingly, this conjecture is supported by the fact that most reported transactions to date do not purport to achieve vertical integration in the end-user smartphone market, but instead target the intermediary component market.

Third, the narrower spread of the bargaining range denotes a reduction in the size of negotiable rewards for SEP owners and lower expected profits from technology licensing. Adverse incentives effects can no longer be excluded. This could manifest itself through a variety of ways. One is that SEP owners may be increasingly reluctant to offer FRAND pledges before SSOs, which

[77] Kamien and Tauman, *supra* note 9.

[78] See Belleflamme, P. and Peitz, M., chapter 18 for a survey. Belleflamme, P. and Peitz, M. 2015. *Industrial Organization Markets and Strategies*. Cambridge: Cambridge University Press.

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apply SSPPU and/or SSPPU+. In this respect, a statistically significant decline of about 85 percent in the FRAND letter of assurances (LoAs) submitted has been documented before IEEE since the change of its patent policy.[79] Another is that SEP owners may find novel ways to eschew SSPPU+ type obligations through convoluted means. For example, it has been reported that Nokia and InterDigital have submitted three *negative* LoAs. Those letters are different from traditional FRAND pledges because they expressly indicate an unwillingness to license under the new IEEE policy. Instead, negative LoAs commit to licensing under the previous IEEE policy. And a last, though extreme, possibility, is that SEP owners may relocate their decisions to partake in collaborative standardization efforts toward non-SSPPU SSOs. To put the point differently, technology developers may invest less time and energy with trade-association or profession oriented "*grey standards*" forums like IEEE or Internet Engineering Task Force (IETF) , which are typically driven by implementers, and favor "*formal standardization*" organizations where they entertain more influence.[80] Technical competition among SSOs for the specification of future wireless communications standards is no new phenomenon, and has been observed on myriad occasions (CDMA v GSM).[81] Patent-policy driven competition among SSOs for the attraction of technology developers, however, would be an unprecedented development. And while technical competition among SSOs is generally perceived as socially beneficial in terms of experimentation, innovation, and dynamic efficiency, it is much less obvious that regulatory competition over patent policy delivers similar welfare improvements.

To date, none of the above effects can yet be observed. These, though, are largely prospective questions falling beyond the scope of this paper. Yet, it might be worth looking at the impact of SSPPU+ on firm strategies in the future, to see whether our intuitions can be empirically confirmed.

[79] Ron Katznelson, *supra* note 31.

[80] Egyedi, T.M. 2000. *Institutional Dilemma in ICT Standardisation: Co-ordinating the Diffusion of Technology? Information Technology Standards and Standardization: A Global Perspective*, chapter 4, Jacobs, K. (ed). London: London Idea Group Publishing.

[81] Gandal, N., Salant, D., and Waverman, L. 2003. Standards in Wireless Telephone Networks, *Telecommunications Policy*, 27:325–332; Cabral, L. and Kretschmer, T. 2006. Standards Battles and Public Policy. In *Standards and Public Policy*, chapter 10, Greenstein, S. and Stango, V. (eds). Cambridge: Cambridge University Press, pp. 329–344.

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