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 towards the calculation of fair, reasonable and non-discriminatory (FRAND) 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 hidden revenue-cap on standardized technologies. Furthermore, SSPPU+ imposes uniform pricing of SEPs across different industries and does not allow SEP owners to take benefit of complementarities between technologies. This pleads against a generalization of SSPPU+ at early standardization and negotiation stages.

JEL Codes: K21, L15, O34
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I. INTRODUCTION

Fixing royalties for licenses over Standard-Essential Patents (SEPs) is a complex issue. Owners of SEPs usually commit to license their technology of fair, reasonable and non-discriminatory (FRAND) terms. However, what constitutes a FRAND royalty is a matter of debate, both in economic theory and in legal scholarship.\(^1\) Several valuation methods compete to guide the determination of appropriate royalties for SEPs in private negotiation and litigation before courts.

The Smallest Salable Patent Pricing Unit (SSPPU) is one of them. Under SSPPU, royalties should reflect the value added to the smallest salable component implementing the patented invention. In recent years, some Standard Setting Organizations like IEEE have envisioned to convert SSPPU into a pricing rule that not only assists the \textit{ex post} assessment of SEPs added-value by courts in the context of patent litigation, but also forces licensing parties to \textit{ex ante} specify royalties terms as a share of component costs in SEP negotiations. We call this evolution of SSPPU towards a more specified component base at the contract formation stage SSPPU\(^+\). This new pricing method would purportedly replace current methods that specify running royalties as a percentage of the entire market value (EMV) of the end product.

When royalties are expressed as percentage, as is common industry practice in the ICT sector, the choice of a royalty basis is \textit{a priori} irrelevant. Whichever of 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 parties’ evaluation in one direction or the other depending on the reference point (the so-called anchoring effects), parties are still bargaining to share the entire amount of surplus. Therefore, a change in the royalty basis should be of little importance.

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 \textit{de facto} impossible to implement. Therefore, a change in the royalty basis is not neutral as parties are no longer bargaining over the entire surplus.

To understand this, recall that royalty negotiations are taking place in

the shadow of litigation. In a FRAND litigation context, courts determine a valuation method for SEPs. Usually, this consists in fixing a royalty rate and a royalty basis. However, if parties ex-ante use component licensing in contractual negotiations – for example because this is recommended or required by an SSO – path-dependent courts are likely to follow this choice, and determine a royalty rate only. The royalty basis discussion does not even enter the scope of the trial. Behavioral bias, including anchoring or unit effects, are likely to lead courts and juries to consider that high nominal royalty rates are “big”, eventually 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). But behavioral constraints make high nominal royalty rates under SSPPU+ look unfair. Moreover, antitrust agencies may deem high nominal rates a form of unlawful exploitative pricing.

Against this backdrop, SSPPU+ sets a de facto price cap on royalty rates. Combined with a given royalty basis, it is equivalent to a hidden revenue cap on a SEP holder licensing revenue. This revenue cap may prevent the SEP owner to collect 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, parties in licensing negotiation do no longer bargain over the entire surplus but only for a fraction of it, the remaining being systematically captured by the licensee. This is likely to create inefficiencies.

Furthermore, if the patented technologies 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 technology developing firm are developing 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 its generalized implementation is complicated. The main arguments are as follows. First, in industries where portfolio licensing is a common practice, SSPPU requires to map each patent to a well-identified component and to determine its individual value. With large portfolio of SEPs and non-SEPS,
this valuation exercise is likely to create substantial transaction costs. And complementarities between patents within a similar portfolio are ignored under SSPPU.

Second, the smallest component in the SSPPU must be “salable” but it does not mean that it is actually sold. This is particularly problematic when firms are vertically integrated. For those firms, there are no proper metering variables and the requirement to use the smallest salable component as a rule is likely to lead to different royalty bases depending on their level of integration. SSPPU is thus likely to create discrimination among patent users i.e. it might be more difficult to enforce the no-discrimination rule imposed by FRAND licensing.

Third, manufacturers create value by combining components and part of this value comes from complementarity between technologies. A 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. 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. The pioneering work of Kamien and Tauman compare a fixed fee licensing to royalties and they show that the former is superior by creating less distortions on the product market. San Martin and Saracho and Llobet and Padilla compare ad-valorem and per-unit royalties with the first being equivalent to using the EMV as the royalty basis and the later the component value. 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

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licensor’s revenue, its incentive to invest and ultimately economic welfare. Therefore, per-unit royalties based on the component’s value and ad-valorem royalties based 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.\footnote{Sidak, Supra note 4.}

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 royalty rate can be adjusted. In Section IV, we show that SSPPU+ is equivalent to a revenue cap on 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

In US and EU law, compensatory damages are due to patent owners in case of infringement.\footnote{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 (‘EU Enforcement Directive’), Article 13(1).} Patent damages are set \textit{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”.\footnote{EU Enforcement Directive, Article 13(1).} And in no event, damages should be “less than a reasonable royalty for the use made of the invention by the infringer”.\footnote{35 U.S. C. § 284.}

The law focuses a standard damages inquiry on either the patent owner’s lost profits\footnote{Lost profits cover lost sales, price erosion effects, and additional costs like litigation expenses for instance.} or – and this is more frequent – 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”.\footnote{See EU Enforcement Directive, Article 13(1)(b).} In the second variant, the idea is to set a \textit{reasonable royalty}. When an established royalty or fee is unavailable, the examiner attempts to reconstruct the outcome of a \textit{hypothetical negotiation} between the patent owner and the infringer.

Courts use a variety of methods to calculate patent damages. In \textit{CSIRO v Cisco}, the Court of Appeals for the Federal Circuit noted that “damages
A central tenet of patent law is that damages should reflect “the value attributable to the infringing features of the [infringing] product and no more”. This is known as the rule of “apportionment”. But when multi-component products are involved apportionment can be tricky. In such cases, damages claimants have two options. First, they may propose to use the entire market value of an end-product as the appropriate royalty base when the patented component is the “basis for demand” for that entire product. 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, sub assembly or 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 US, 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, the Federal Circuit also noted that SSPPU is “untenable” as a rule. It stressed its derogatory nature, insisting that “licensed based evidence” remains the preferred method when rates for comparable licenses are available.

Courts are, however, 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 US than in the EU where bench trials are the rule. This is because jury trials present a “unique apportionment concern”. When non-expert juries are called to set reasonable royalties, use of the EMV method may mislead juries into

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15 This problem occurs essentially in practice with running royalties calculated on units produced or sold, as opposed to a lump sum royalty.
17 CSIRO v Cisco, supra note 13.
18 Though this is very uncommon, see Blair & Cotter, supra note 16, p. 211.
19 CSIRO v Cisco, supra note 13, a bench trial, was conducted under the EMV.
overcompensation by making the claimed royalty look low. The use of such base “cannot help but skew the damages horizon for the jury” and “make a patentee’s proffered damages amount appear modest by comparison”. Stark notes that SSPPU was developed to offset a “perceived tendency of jurors to overestimate reasonable royalties that might be agreed to in hypothetical negotiations”.

But 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”. 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, some prominent Standard Setting Organizations (“SSOs”) have proposed to use of SSPPU as the appropriate valuation method in all ex ante patent licensing negotiations. On the one hand, some prominent Standard Setting Organizations (“SSOs”) have proposed to use of SSPPU as the appropriate valuation method in all ex ante patent licensing negotiations over Standard Essential Patents covered by a FRAND commitment. 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”. In practical terms, the IEEE-SA suggests to links the valuation discussion to the smallest component that implements the patent. And 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 has received mixed feelings amongst practitioners.

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21 Uniloc USA v. Microsoft, 632 F.3d 1292 (Fed. Cir. 2011), at pp. 51-52.
22 LaserDynamics v. Quanta Computer, 694 F.3d 51 (Fed. Cir. 2012).
23 Stark, supra note 4.
25 Note that in some sectors like wireless communications, SEPs licensing occurs on a global scale. The proposed expansion would thus lead to the introduction of SSPPU well beyond the US.
27 Ron Katznelson, The IEEE controversial policy on Standard Essential Patents – the Empirical Record since Adoption, Mimeo (2016).
On the other hand, several antitrust agencies have taken initiatives that lean towards a generalization of component licensing as the *pricing rule* 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 a SEP (or a portfolio thereof) that covers wireless connectivity technology for airlines’ in-flight entertainment sets. Having calculated the added-value to the smallest salable component under the IEEE-SA valuation method, here a radio 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 antitrust initiatives follow distinct, uncoordinated routes. In Asia, the Korea Fair Trade Commission (KFTC) has ruled in 2016 that Qualcomm had abused a 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.\(^{28}\) In the European Union (EU), a discussion has taken place on whether the “ND” limb of FRAND implies that owners of SEPs declared to ETSI have a duty to license “at all levels.”\(^{29}\) In relation to 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 end-user device level. And in the US, Apple is currently complaining before the FTC 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 touch-screen displays, powerful applications and graphics processors—other than cellular connectivity.\(^{30}\) In effect, all those antitrust initiatives 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-

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\(^{29}\) Huber, Bertram, *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.

\(^{30}\) Rosenbrock, Karl Heinz, *Licensing At All Levels Is The Rule Under The ETSI IPR Policy: A Response to Dr. Bertram Huber* (2017). Available at SSRN.

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, like wireless communications, medical devices or food ingredients.\(^{31}\)

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 a 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).

**A. The Neutrality of Multiplication**

Let us consider an industry in which a SEP owner and a multi-component product manufacturer negotiate percentage royalties. The total royalty revenue that the SEP owner can expect is equal to the royalty rate multiplied by the royalty base:

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\text{Royalty revenue} = \text{royalty rate} \times \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.\(^{32}\) The chipset is integrated in 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% royalty rate on the end-product value.

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\(^{31}\) 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 Eric Stasik, *Royalty Rates and Licensing Strategies for Essential Patents on LTE (4G) Telecommunications Standards*, LES NOUVELLES, 114–119 (2010).

\(^{32}\) The price of a chipset processing unit is usually between $16 to $18 but baseband processors can be sold for between $30 and $40.

Alternatively, the parties can contract a 500% 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% of $1000 = 500% 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.33

This result is an application of the royalty allocation neutrality result of Layne-Farrar et al.34 They 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 economics shows that economic agents’ decisions are based on heuristics.35 As a result, their behavior often deviate 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.36 The idea is

33 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 5 and San Martin and Samacho, Llobet and Padilla supra note 6 for models where the choice a royalty base impact competition on the market.


35 This term denotes intuitive, rapid, automatic and often simple rules of thumb.

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 towards the initial value that is presented to them.\footnote{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. Dan Ariely, George Lowenstein and Drazen Prelec, Coherent Arbirariness: Stable Demand Curves without Stable Preferences, 118 The Quarterly Journal of Economics, 73-104 (2003).} Hence the term anchoring. In the seminal experiment of Tversky and Kaneman, participants spun a wheel of fortune and received a percentage number, 10\% or 65\%. 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\%) reported a median 25\% and those with a higher stating value (65\%) reported a median 45\%.

The anchoring effect suggests that the estimated value of a SEP protected technology may be assessed differently if the initial reference for the royalty base is a $1,000 handset or a $10 chip set. 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 instance $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 a SEP owner and a prospective licensee.

\textit{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.\footnote{Sidak supra note 4.} 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 WTB is a function of the costs
incurred to manufacture a compliant product, and of the opportunity costs
of redesigning a non-infringing product. The lower bound represents the
lowest valuation at which the SEP owner is willing to sell (WTS) the
technology. The WTS is essentially a function of the sunk costs incurred to
develop the technology, and of the opportunity costs of non-transacting.

If the bargaining range is non-empty i.e. 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 that 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 non-empty.

![Figure 1: The bargaining range](image)

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
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 in a symmetric way. 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 the negotiated royalty level is for instance 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 on Figures 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. 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 parties. Pricing effects will have been anticipated and internalized by industry participants, when they made the decision to invest.\footnote{As long as this valuation system was anticipated and applicable prior to 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.}

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”.\footnote{Oscar Bergman, Tore Ellingsen, Magnus Johannesson and Cicek Svensson, \textit{Anchoring and Cognitive Ability}, 107 ECONOMICS LETTERS, 66-68.} 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.\footnote{Adam Galinsky and Thomas Mussweiler, \textit{First Offers as Anchors: the Role of Perspective Taking and Negotiator Focus}. 81 \textit{JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY}, 657–669 (2001).} 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 in 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 effects will influence the computation of damages in courts if judges apply SSPPU as the basis for fixing royalties.

IV. SSPPU+, Hidden Revenue Cap and Economic Surplus Redistribution

In an industry subject to SSPPU, there is a lower valuation for the technology which 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 – namely 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 hidden revenue cap (B). Given this cap, patented technologies will be sold at a uniform price across industries, failing to internalize complementarities (C).

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% royalty rate will be perceived as “high” while a 5% 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,\(^43\) the application of SSPPU+ (that is component licensing) to a $10 chipset produces a royalty rate specification of 500% and 300% respectively, whereas end-user licensing produces a royalty rate specification of 5% and 3% 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.\(^44\) But, if a change in the royalty

\(^{43}\) Unit effects are not specific to SSPPU and can also exist with EMV, as long as component licensing is applicable.

\(^{44}\) It is often said that there is a 25% rate 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. Robert Goldscheider, John Jarosz and Carla Mulhern, *Use Of The 25 Per Cent Rule In Valuing IP*, LES NOUVELLES, 123-133 (2002); Richard
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%. 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%, leading to a change in royalty revenue from $23 billion to $6.6 billion. This example, described in greater details by Putnam and Williams, 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 legislation 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 various legal doctrines that we discuss hereafter.

*First*, in all antitrust jurisdictions where a system of control of excessive prices exists, like the EU, China and Korea and many others, high nominal royalty rates are not in the cards. 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”. In practice, agencies and courts have consistently deemed unfair prices which exceed costs by more than 100% the value of the product/service in question. In more recent cases, the Court said that


45 Putnam and Williams, supra note 3.


an unreasonable price was one that is “prohibitive”. In the area of cartel law, antitrust authorities even go as far as to consider that a 25% 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 the EU, China, Korea and many other jurisdictions. In the US, a similar effect is achieved through contract law, when FRAND terms are interpreted as requiring patent owners to their SEPs to modem chip suppliers. 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. The concrete implication of such duties is to trigger the application of intrusive 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 which impose on dominant firms a duty to license also force them to transact on 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 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 case. Having imposed a duty to license interoperability information on Microsoft, complex discussions were engaged to find agreement on “reasonable and non-discriminatory terms”. The case ended in Court, and a large fine was inflicted on Microsoft for failure to offer FRAND rates.

Agency was concerned that the price charged by the Belgian incumbent telephony operator to publisher of telephone directories were almost 100% above the costs it incurred for the collection, treatment and provision of data to the directories publishers. Under such prohibitions, any royalty rate that represent one or more times the value of the component could be deemed unlawful. And in British Leyland, the 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 600% during the relevant period, and considered as a result that they were abusive.


49 FTC v Qualcomm, Order Granting FTC’s Motion for Partial Summary Judgment, 06 November 2018, Case No. 17-CV-00220-LHK.

50 “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”.

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 Huawei v ZTE, the Court of Justice of the EU said that FRAND discussions ought to comply with “recognized commercial practices in the field”. The effect of such case-law doctrines is to transform informal industry practice into legally enforceable principles. The US approach to FRAND puts emphasis on royalty rate levels, and the evidentiary rules suggest to use comparable licenses in order to determine the FRAND royalty rate. 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% industry norm. Under this rule (of thumb), an IP owner can legitimately receive a royalty rate equivalent to 25 per cent of the expected revenue for the application that practices the IP at issue. When significant, deviations from the 25% may be conducive to antitrust liability.

Fourth, a convoluted way to prevent SEP owners to extract royalties from the end-product involves the application of the antitrust rules together with the doctrine of “patent exhaustion”. This could apply in the specific scenario where a SEP owner conditions the granting of license to a chip maker to an obligation to sell only to device makers who have themselves 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+ committed antitrust agency could come to the realization that multi-level licensing undermines the whole point of seeking to reduce the royalty burden in SEP-intense industries. Such agencies may thus attempt to prevent multi-level licensing, by considering that contractual terms conditioning the granting of a license to resale restrictions are either abusive in themselves 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”.

Note that none of the above antitrust 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 non-trivial chance that an agency could attempt to experiment one

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53 Belgun, supra note 50.
or all of such novel interpretations, anticipating to be backed by review courts when its decision will be challenged.

\[ \text{B. Hidden Revenue Cap and Economic Surplus Redistribution} \]

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 hidden revenue cap on the total royalty payment for the SEP owner.

Let us denote by \( r_{\text{max}} \), 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:

\[ R_{\text{max}} = r_{\text{max}} \times C_k \quad (2) \]

The hidden revenue cap means that the SEP owner cannot expect to receive more than \( R_{\text{max}} \), should negotiation break down, and the licensing rate be fixed by a court, arbitration tribunal or antitrust agency. The hidden revenue cap shrinks the zone covered by the bargaining range in royalty negotiations. The story depicted in Figure 2 is therefore incomplete. If \( R_{\text{max}} < WTB \), the upper bound of the bargaining range is fixed by the hidden 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 \( R_{\text{max}} \), considering that the bargaining range is non-empty. As it is shown on the Figure, with a hidden revenue cap, the surplus and the bargaining range do no longer coincide. The surplus is the difference between the \( WTB \) and the \( WTS \), the bargaining range the difference between \( R_{\text{max}} \) and \( WTS \). This means that the parties no longer bargain to share the entire surplus. The imposition of such a revenue cap has thereore important redistributive effects.
1. Redistribution to Implementers

The first redistributive effect consists in a transfer of surplus to SEP implementers. As can be seen on figure 3, the bargaining range is a subset of the economic surplus. Due to the abovementioned 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 \(R_{\text{max}}-WTS\). Unless the SEP owner enjoys greater bargaining power, the distribution of surplus under SSPPU+ is biased towards implementers.

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 i.e. the smallest component cost in the SSPPU. This has one 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 use the chipset cost as a proxy, because it will often be the only available metric to discuss the value added to the component.\textsuperscript{54} Moreover, antitrust law often dictates to look at cost as a proxy for economic value. In \textit{United Brands}, the EU courts said that the economic value of a product could be assessed by looking at its cost of production.\textsuperscript{55} 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 amongst SEP owners

The biased distribution of surplus may also occur amongst 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 amongst 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 respectively $C^A=$1 and $C^B=$2. When the royalty basis is the component cost, SEP owner A must apply a 500% royalty rate and SEP owner B a 250% royalty rate to collect the same surplus. Clearly the same revenue sharing cannot be implemented with SSPPU+ and SEP.

\textsuperscript{54} As Kappos and Michell, supra note 24: “\textit{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”.

\textsuperscript{55} United Brands, supra note 46.
owners will collect lower royalties. Consequently, the implementer collects a larger share of the surplus.

Now suppose that $C^A = $1 but $C^B = $7. In this case, by applying a 100% royalty rate, SEP owners A and B will collect a surplus of respectively $1 and $7 while the implementer has a surplus of $13. 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. Whilst the revenue cap is strong for SEPs with low cost implementations, it is much less constraining for SEPs with high costs implementations, because the later 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.\textsuperscript{56}

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 $R_{\text{max}}$ 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.\textsuperscript{57}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure4.png}
\caption{Impossibility of trade}
\end{figure}

\textsuperscript{56} Putnam and William, supra note 3.
\textsuperscript{57} Sidak supra note 4 says that there is no voluntary agreement in reach.
Let us revert to our initial example. Assume that SSPPU+ lays down an implicit cap of a 100% cap on the royalty rate. If the component cost is $10, the highest revenue for the seller is 100% 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.

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 non-trivial 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 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 Internet of Things, a whole set of objects (physical objects, home appliances, vehicles) will be equipped with communications chips and sensor. However, the value of a 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 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 combined 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 i.e. linked to the component value $C^A=S5$. Therefore in both sectors, the bargaining range will have the same upper bound corresponding to the hidden 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 limiting the nominal royalty rate, the SSPPU+ fails to take into account the externalities and complementarities created by a technology, at 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 general purpose technologies (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. 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.

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 it that the efficiency of the generic technology improves continuously, which drives further adoption in novel applications sectors. Third, GPTs benefit from “innovational complementarities” with using products, in the sense that improvements in the GPT makes it more profitable for applications developers to innovate, which in turn increases demand for, and investments in, the GPT itself.

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). In the literature, externalities also do not diffuse instantly, and are instead subject to significant time gaps and sequentiality.

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

![Figure 5: GPT Timing and Optimal Appropriability Policy](image)


61 Bresnahan and Trajtenberg, supra note 61.

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.63 Which of both effects dominates the other is, however, unclear. Bresnahan and Trajtenberg note that “pricing rules [will imply] that neither side will have sufficient incentives to innovate”.64 But several studies call our attention to the “time horizon”.65 As explained before, 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 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”.66 Helpman and Trajtenberg briefly mention, but without more details, antitrust and intellectual property. Yet, this brings some perspective to the specific SEP context, where some authors have argued that the SSPPU implies that the SEP owner should not benefit from standardization via a price effect but only via a volume effect.67

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, recall that there is considerable uncertainty in the ability to identify GPTs both prospectively and retrospectively. From a policy standpoint, this 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 a technology can

63 Bresnahan and Trajtenberg, supra note 61.
64 Id.
65 Elhanan Helpman and Manuel Trajtenberg, supra note 65;
 « 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 »
66 Helpman and Trajtenberg, supra note 65.
be better verified.

Second, if policy makers 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 we try apply this to standards, and in particular to wireless communications standards where SSPPU+ is in discussion, we can instantly notice practical difficulties. Whilst 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 perspective, then the exact location of the policy maker 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 later hypothesis – early wireless communications standards were the GPT – then appropriability-friendly measures seem warranted. This question, which is largely empirical, is however rendered even more complicated due to the introduction of evolutionary versions of wireless standards, like EDGE (2,5G) or LTE (3,5G).

Purely anecdotal reasons, however, raise doubts that each wireless standard could 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 the base, generic technology as the GPT. We see no obvious reason to treat wireless communications differently.

**CONCLUSION**

This paper has explored the effects of a widespread generalization of SSPPU+ pricing from both a 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 hidden revenue cap on standardized technologies, and distorts the distribution of revenue in ways adverse to technology developers. 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 licensing firms may switch to alternative valuation models, like fixed fee licensing. Following Kamien and Tauman\(^{68}\), 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.\(^ {69}\)

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 possibly be explained on that ground (Qualcomm 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. With this, expected profits from technology licensing decrease. Adverse incentives effects can no longer be excluded. In the first place, firms incentives to participate to SSOs may decrease. 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 apply SSPPU and/or SSPPU+. In this respect, a statistically significant decline of about 85% in the FRAND letter of assurances (LoAs) submitted has been documented before IEEE since the change of its patent policy.\(^ {70}\) Another one 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 unwillingness to license under the new IEEE policy. Instead, negative LoAs commit to license under the previous IEEE policy. And a last

\(^{68}\) Kamien and Tauman, supra note 5.


\(^{70}\) Ron Katznelson, *supra* note 27.
possibility, is that SEP owners may relocate their membership decisions
towards non-SSPU SSOs. Or to put the point differently, technology
developers may abandon trade-association or profession oriented “grey
standards” forums like IEEE or IETF which are typically driven by
implementers, and favor “formal standardization” organizations where they
entertain more influence.\textsuperscript{71} Technical competition amongst SSOs for the
specification of future wireless communications standards is not a new
phenomenon, and has been observed on myriad occasions (CDMA v
GSM).\textsuperscript{72} But patent-policy driven competition amongst SSOs for the
attraction of technology developers would be an unprecedented
development. To date, no such effect can yet be observed, but it might be
worth looking at the impact of SSPU+ on the locus of standardization in the
future, to see whether our intuitions can be empirically confirmed.

Last, firms may even reconsider their decision to invest into
patentable technologies, participate in standard setting processes and exit
the industry altogether. But those are largely empirical and prospective
questions which fall beyond the scope of this paper.

\textsuperscript{71} Tineke M. Egyedi, \textit{Institutional Dilemma in ICT Standardisation: Co-ordinating the
Diffusion of Technology?}, Chapter 4 in K. Jacobs (ed) Information Technology Standards
(2000).

\textsuperscript{72} Neil Gandal, David Salant, and Leonard Waiverman, \textit{Standards in Wireless
Telephone Networks}, 27 \textit{Telecommunications Policy}, 325-332 (2003); Luis Cabral and
Tobias Kretschmer, \textit{Standards Battles and Public Policy}, in Shane Greenstein and Victor
Stango \textit{Standards and Public Policy}, chapter 10, 329-344, Cambridge University Press,