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A Comparative International Analysis of Innovation and Imitation Incentives from Patent Indemnification Rules

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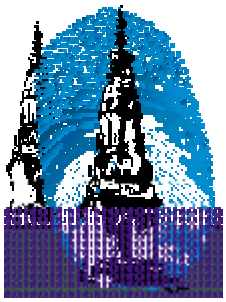

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Abstract:

This paper contributes to the fundamental discussion of setting optimal liabilities in restitution law by analyzing the effects that the existing multitude of indemnification rules for patent infringements have on innovative and imitative activity. From a theoretical legal standpoint, the choice of patent law is particularly enlightening due to its hybrid public and private nature. From an economic perspective its relevance lies in regulating the driving forces of welfare in highly industrialized societies. Our analysis of regulations from six different jurisdictions (US, JP, DE, UK, FR, NL) reveals that from a scholarly standpoint none of the regulations sets optimal liabilities in general. Our major finding is that an expectation damage rule based on a renegotiation outcome from an *ex-ante* perspective (falling in between the generic legal notions of 'lost profits' and 'infringer's profits') between licensor and licensee appears optimal in patent infringement cases to avoid dynamic inefficiencies. The result is intuitive, however, was not predicted by the existing literature on indemnification law.

Keywords: Patents, litigation, damage awards, innovation, infringement

JEL-Classifications: K41,L00, L20

1. Introduction

Theoretical scholars have studied the optimal setting of liabilities for damages in both public (see Polinsky and Shavell, 1994) and private contract law (see Che and Chung, 1999; Schweizer, 2003). Patent rights are regarded as property rights conferred by the *public* (*state)* in virtually all jurisdictions despite residual dogmatic inconsistencies associated with this view.[5] At the same time, the field of patent law has a strong *private legal* component in that the (1) contractual (cross-)licensing of protected investments characterizes modern industries and (2) the patent holder bears full responsibility for the enforcement of his property right. Hence, one would suspect that patent indemnification rules belong to the most sophisticated and unambiguous damage awards regulations as they are of interest for both policy makers and private parties. Surprisingly from an economic standpoint, however, patent damage awards may be calculated following various different rationales not only across different jurisdictions but at most times even within the same legal system. Three forms of possible damage award calculations reappear in slightly different fashion within most Western (including Japanese) legal systems, namely "lost profits," "infringer's profits," and "reasonable royalty rates." Damages calculated as "lost profits" refer to the losses incurred by the patent owner compared to the hypothetical situation in which he/she would have produced and sold the patented technology without being infringed. "Infringer's profits" are the net profits of the third party gained through the unlawful use of the patented technology. And finally, patent holders may sue their infringers for the payment of a virtual royalty fee that is calculated on the fictitious assumption that holder and infringer had entered a licensing agreement before the unlawful use of the protected technology took place.[6] Whilst there may

[5] E.g., the preamble of the WTO/TRIPs Agreement according to which members recognize "that intellectual property rights are private rights."

[6] The details of the different damage award rules and their realizations across different jurisdictions are described in part two of this paper.

be some reason for the existence of these different forms of calculations[7] from a practical point of view, from a scholarly view it appears problematic that the plaintiff may choose between three or more potential damage awards in only one infringement case.[8] This freedom of choice may well be inefficient from a social welfare point of view. As a matter of fact, the incentives to *deliberately* infringe other people's patents in the first place[9] and incentives to then pursue the infringer(s) make it difficult to say whether patent enforcement rules still serve to maximize overall welfare or not. A lot might depend on the assessment of economically appropriate damages in such cases.

Who could tell, e.g., whether Mattel, Inc. would ever have licensed Lemelson's patent to produce a toy truck at a royalty rate of 4.5% arriving at a payment of almost US$ 25 million total?[10] In producing the truck toy by itself, would Lemelson have gained the same profits? Vice versa, would Mattel, Inc. have had even better incentives to innovate had they anticipated that Lemelson would sue them for the total infringer's profits? And would this have been desirable from a social welfare point of view?

Would Conair from the beginning have entered into a US$ 28.5 million licensing agreement with Dr. Gaus on his circuits used to protect users of hand-held hair dryers from being electrocuted when the dryers are immersed in water if Conair had to fear a verdict on the payment of infringer's profits?[11] Could the trial have been avoided, and would this have been overall efficient?

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7 The rule to award fictitious reasonable royalties is, in fact, an expedient to lower the burden of proof for the plaintiff compared to a scenario in which he/she seeks a verdict on lost profits or infringer's profits.

8 We will elaborate on this point in more detail in section two.

9 This paper discusses the effects of both *deliberate* and *inadvertent* infringements (see Bebchuck and Png, 1999) on innovation and imitation incentives from an *ex-ante* perspective.

10 See Lemelson v. Mattel, U.S. District Court for the Northern District of Illinois, No. 77 C 4558.

11 See "Jury Blows Away Conair with $ 28.5 M Infringement Award," Litigation Week, February 11,

What incentives are provided for competitors of the SquareD company by the award of US$ 13.2 million in damages that SquareD had to pay to Mr. and Ms. Calabrese for the infringement of their relay system for accessing large quantities of data?[12] Is infringement profitable? Or is being infringed profitable? And how does this equation affect incentives to innovate?

The examples show that the rules of patent infringement go far beyond the broadly discussed problem of establishing legal certainty for patent owners. Patent infringement rules touch the patent system at its economic heart. They have an impact on the incentives for companies and individuals to innovate, imitate, and cooperate. And a simple glance at the size of the awarded sums to successful plaintiffs underscores the practical relevance of these regulations in the field of patent economics. From a scholarly perspective, patent damage awards rules are interesting because of their 'hybrid' public and private legal character. Their public law characteristics account for their importance of setting optimal innovation and imitation incentives and relate to the works of Polinsky and Shavell (1994). Their private component – particularly reflected in the remedy of a 'reasonable royalty' – links them to the contributions on co-operative investment (Che and Chung, 1999; Schweizer, 2003).

This paper studies the phenomena associated with the different rules for awarding damages in the international patent system. It deals with a very relevant intersection of law and economics that has steadily seen various important contributions over the last years.[13] In

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2002.

12 See Calabrese v. SquareD, U.S. District Court for the Northern District of Illinois, No. 97 C 2199.

13 On the economic relevance of patent litigation see Lanjouw (1998), Lanjouw and Schankermann (2000), Harhoff and Reitzig (2001). Quite a few articles by legal scholars have been published on multiple damage award calculations. For Germany see, e.g., Assman (1985), Heil and Ross (1994), Karnell (1996), Lehmann (1998), and Vollrath (1993). Economic aspects of patent indemnification are treated by Ayres and Klemperer (1999), Conley (1987) and Schankerman and Scotchmer (2001).

contrast to most of the existing studies to date, however, this paper neither takes up the fundamental discussion of liability vs. property rights,[14] nor the patent system's entire suitability of setting incentives for R&D. Instead it focuses on the suitability of patent liability rules and brings together two fundamental streams of literature in the field, namely the literature on patent law and on the regulation of liabilities. Within a given legal reality characterized by the existing patent systems in the world, we present a theoretical economic analysis of the effects exerted by indemnification rules on innovation incentives and disincentives in a dynamic setting. Similar to Blair and Cotter (1998, 2001) we analyze the economic effects of damage award rules in detail, while introducing three major new aspects. On the economic side, we first introduce the premise that an optimal patent indemnification rule must be dynamically efficient before we then seek to identify an optimal regulation and contrast it with existing indemnification rules; i.e., their suitability to take account of the effects on overall efficiency exerted by plaintiffs' and defendants' respective *capacities* to produce patent protected goods. On the legal side, to the best of our knowledge we present the first *international comparative study* analyzing the dogmatic frameworks of six major patent jurisdictions[15] with respect to indemnification rules. The joint discussion of economic and legal aspects allows us to illustrate comparative (dis)advantages of indemnification rules across jurisdictions from an economic standpoint for the first time in an academic paper, and develop some very basic hypotheses on how patent indemnification rules may affect the development of certain technical sectors across countries. Like Bebchuck (2001), our paper

[14] See Calabresi and Melamad (1972), Kaplow and Shavell (1996), and Melville (1999).

[15] We analyze indemnification rules from the U.S., Japan, the three major European economies, and the Netherlands. The latter country was included as it often serves as a stage for international infringement trials in Europe.

takes a strict *ex-ante* perspective to allow the discussion of innovation and imitation incentives, and attempts to avoid sanctimonious *ex-post* exhortations.[16]

The remainder of the paper is structured as follows. Part two summarizes the legal principles and applied rules for indemnification across different countries and identifies the three 'generic' damage awards that globally reoccur in slightly varying fashion. Section three then compares those three different legal regulations from an economic point of view and discusses basic implications for the innovation and imitation incentives that derive from these different rules. In particular (in section four), we model the impacts of companies' capacities and competitive characteristics on innovation incentives and disincentives. In part five the paper discusses the findings theoretically and from a legal policy perspective. The discussion starts from the results of the economic analysis of the generic damage award types, and is then expanded to the effects of differences in national patent indemnification rules. Finally, section six summarizes the main results and provides and outlook on potential future research triggered by this paper.

2. Patent Infringement Indemnification – An International Comparison of Existing Regulations

There are two types of remedies against patent infringement: injunctive relief and damages. Requesting the infringer to cease the infringing activity is always possible regardless of the amount of damage the patentee has actually suffered. The recovery of damages is an acknowledged remedy in all cases where property rights have been infringed.

[16] The *ex-ante* perspective appears especially important in cases where *ex-post* bargaining is difficult. This is particularly true for patent infringement cases where infringements can lead to irreversible changes in the bargaining power of one party (e.g., because of bankruptcy or loss of market power).

Damages incurred in the case of patent infringement are notoriously difficult to calculate, however, due to the intangible nature of the right. Most jurisdictions provide for a number of methods for calculating damages. They differ with respect to their understanding of what "damages" actually are, as well as the required effort from the plaintiff and the court to apply calculation methods. Most jurisdictions would regard damage awards as compensation for loss rather than a punishment for unlawful behavior.[17] Some of the differences among the calculation methods observed at the international level are due to a different understanding across countries as to whether damages shall be punitive or not. While international agreements on matters of industrial property such as the Paris Convention 1883 or the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs) of 1994 harmonize a number of aspects, the recovery of damages is not among them. Art. 45.1 TRIPs only states the general rule that damages are meant "to compensate for the injury the right holder has suffered because of an infringement of his intellectual property right." Some of the differences among the calculation methods, however, even exist on the national level. In various countries (e.g., the U.S., Japan, Germany, the U.K., France, and the Netherlands) the plaintiff can choose between several methods he/she wants to be applied for his/her case. A precise comparison of all the different methods is difficult for various reasons. However, there are three principal or generic methods of damage calculation, namely the patentee's own damages, the infringer's profits, and an ordinary licensing fee.

2.1. Obtaining Evidence of the Scope of Infringement

In principle, the law acknowledges that regardless of how damages are calculated, the intangible nature of the patent right in question requires certain information from the

[17] With the notable exception of the United States that awards punitive damages "up to three times the amount found or assessed" (35 U.S.C. § 284) depending on the "egregiousness of the defendant's conduct" (Ortho Pharmaceutical Corporation v. Smith, March 19, 1992, 959 F.2d 936 (Fed. Cir. 1992)).

infringer. From a practical standpoint (i.e., to satisfy legal constraints) the patentee requires information about the infringer's turnover to calculate lost profits or an ordinary licensing fee.[18] When claiming the infringer's profits, the infringer's accounting data will have to be presented in court. Instruments and scope of obtaining such information from the other side widely differ amongst the countries monitored.

The furthest reaching is the U.S. discovery procedure that allows both sides to request all information from the other side prior to trial. While this information may help to assess the case, it is also very costly.[19] A search of the other side's premises can be requested by the U.K. Search Order or the French *saisie contrefaçon*. Discovery or search orders are alien to the German and Japanese legal systems. While German law offers very little help to the patentee in ascertaining infringement, once the infringer's liability has been established in principle, the court can order the infringer to give a detailed account of profits and turnover under Sec. 259 Civil Code. On this basis, the right owner can then choose which type of calculation he prefers to use. Japanese law has given a similar remedy to the patentee in Sec. 105(2) Patent Act.

In general, one may say that the costs for the plaintiff are lowest when suing for an ordinary license fee, higher in cases of claiming lost profits, and highest for infringer's profits.

2.2. Calculation Methods

Legal practice for the calculation of either one of the generic damage awards can be categorized as follows:

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[18] Note that from an economic standpoint far more information may be needed.

[19] According to Maloney, (2000:723-730), more than 50 percent of litigation costs are incurred through the end of discovery. Even for cases with a potentially low value at risk (below US$1 million), an average of US$199,000 is spent on pre-trial phases of infringement litigation.

a) Lost Profits

Here, the patentee shall be reinstated in a position where he/she would have been but for the infringement, with the restriction that only losses from the patentee's own production are taken into account, not, e.g., from licensing (see below). The calculation method is accepted by all major jurisdictions (U.S.: 35 USC § 284; Japan: Sec. 102(1) Patent Act; Germany: Sec. 139 Patent Act; U.K.: Sec. 59 Patents Act; France: Art. L615-1(2) Intellectual Property Code). The leading U.S. case required the patentee in such case to show the following:[20]

(1) demand for the patented product (as indicated by past sales);

(2) absence of competing and non-infringing products (see below);

(3) ability of the patent owner to actually market the quantity of goods[21] for which lost profits are claimed;[22] and

(4) the amount of profit that would have been made in the absence of infringement.[23]

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20 Panduit Corp. v. Stahlin Brothers Fiberworks, April 25, 1978, 575 F.2d 1152 (6th Circuit 1978).

21 The *existing* law generally accepts that in the absence of marketing capacity, the patentee cannot claim lost profits due to a lack of causality.

22 A requirement that is also specifically mentioned in Sec. 102(1) Japanese Patent Act and that has been applied in the UK decision Catnik Components v. Hill & Smith [2], English High Court, March 16, 1983 [1983] F.S.R. 512. Also the German courts require demand for the product and actual production capacity: German Federal Supreme Court, July 10, 1979, GRUR 1979, 869-872.

23 Only Japanese (and Korean) patent law differs in this respect: Sec. 102(1) Japanese Patent Act allows the patentee to calculate his damages by multiplying the number of infringing products sold by the infringer by the profit the patentee would ordinarily realize when selling his own products. Such calculation method has been explicitly rejected by the UK decision Gerber Garment Technology v. Lectra Systems, Patents Court, March 20, 1995 [1995] R.P.C. 383, and the German decision, Federal Supreme Court, March 6, 1980, GRUR 1980, 844 – "Tolbudamid": "Uncertainty that one does not

Where competing and non-infringing products are on the market, element (2) above requires a so-called market share analysis and an award based on a pro rata percentage of the infringer's sales.[24] Lost profits cannot be awarded where the infringing products do not qualify as a substitute for the ones of the patentee.[25] Or, to put it in the words of the German Imperial Supreme Court: "If there is no likelihood whatsoever that the commercial turnover of the infringer would have been made by the patentee, the latter has to furnish proof that he would have indeed made part or all of the sales the defendant actually made."[26]

b) Ordinary Licensing Fee

The most common form of claiming damages is the reasonable royalty for three reasons. First, it is the form of indemnification where plaintiff and defendant can bilaterally agree on the size of the reward. Second, other than in the case where the plaintiff files for lost profits or infringer's profits, only relatively little effort has to be expended by the right owner to prove his case. Finally, many patent owners do not wish to lay open their internal cost structures (which they would have to when filing for lost profits, but – strangely – not in the case of an ordinary license fee).

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know if the defendant would have been able to achieve the same turnover in infringing products at higher prices."

[24] E.g., U.S. decision State Industries Inc. v. More-Flo Industries Inc., 883 F.2d 1573 (Fed. Cir. 1989); U.K. decision Catnic Components v. Hill & Smith [2], English High Court, March 16, 1983, 1983 FSR 512.

[25] U.S. decision Bic Leisure Products v. Windsurfing International, August 4, 1993, 1F.3d 1214 (Fed. Cir. 1993).

[26] Imperial Supreme Court, February 23, 1920, GRUR 1920, 103.

It is standard practice to calculate a reasonable royalty "on the basis of what royalty a willing licensee would have been prepared to pay and a willing licensor to accept."[27] It is noteworthy that all jurisdictions monitored seem to treat the infringer in such case not different from an ordinary licensee, sometimes even better: Until about 1998, it was standard practice in Japan to use royalty rates calculated by over-the-board industrial averages of royalty rates between Japanese companies for domestic patents.[28] This changed once the word "ordinary" was deleted from the wording of Sec. 102(2) Japanese Patent Act.

From a doctrinal point of view, claiming a reasonable royalty is not a compensation for damages, but a form of compensation for unjust enrichment achieved by using an exclusive right without permission that the infringer, had he behaved lawfully, could have only used upon payment of a royalty.[29]

c) Infringer's Profits

Some jurisdictions allow the patentee to recover the infringer's profits as one way of calculating damages. This is not allowed in the U.S. and France, and in Japan it is limited to

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27 U.K. decision Catnic Components v. Hill & Smith, (above footnote 25).

28 Such statistical averages were taken from Hatsumei Kyokai (ed.), Jisshi ryôritsu (Use and Compensation) (Tokyo 1980); Hatsumei Kyokai (ed.), Gijutsu torihiki to royalty (Technology Transfer and Royalties) (Tokyo 1992).

29 It should finally be noted that while in the U.K. (see note 25 supra) courts allow for a combination of the above two methods (lost profits for those infringing items where the patentee can show marketing capacity and causal loss, a reasonable royalty for all those infringing items sold on top of this), German courts do not. It might thus be preferable for a German patentee to claim a licensing fee for the whole amount of infringing items where insufficient marketing capacity would not allow a lost profits claim for the whole amount.

cases where the patentee has actually used the patent.[30] In the U.K., the claim for the infringer's profits is statute based (Sec. 60 UK Patent Act: "account of profits"), and in Germany based on the legal fiction that in using another's patent, the infringer undertook a business on behalf of the right owner, who would thus be entitled to obtain all profits made from such business.[31] Both jurisdictions allow fairly generous deductions where the infringer has used his own skill, labor and expenses in the marketing of the infringing products.[32]

Despite the efforts of legal doctrine to arrive at appropriate damage figures, the assessment of damage awards in reality often appears bleak. Damage awards often boil down to a "compulsory licence for the past,"[33] and the sums granted in court cases may become so low for all kinds of cultural but not economic reasons that they hardly reflect the real damages and sometimes not even merit the effort of a suit.[34]

The following Table 1 summarizes the calculation methods and how they are applied in the listed countries.[35] It also shows in which of the countries plaintiffs may choose among several calculation methods.

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30 Osaka District Court, March 27, 1980.

31 E.g., German Imperial Supreme Court, October 22, 1930, RGZ 130, 108.

32 For the U.K., Gerber v. Lectra (above footnote 24); for Germany, Düsseldorf District Court, July 25, 1996, 4 O 217/95 – "Winkelprofil III." However, according to the German Federal Supreme Court, the infringer cannot deduct costs that relate to general management expenses: German Federal Supreme Court, November 2, 2000, GRUR 2001, 329 – "Gemeinkostenanteil."

33 Casucci (2000:692/702).

34 E.g., in the case of France, "damages granted by the courts are in the amount of 40,000€. In only nine of the 82 reported cases, would the damages and interest exceed 80,000€": P. Véron, *see* "Le contentieux des brevets d'invention, Etude statitique sur 1990-1996 pour la Fédération Nationale des Entreprises (FNDE)-ASPI" (Legal Questions Involving Patents in France, Statistics of 1990-1996) compiled on the basis of figures by the Ministry of Justice, (FNDE)-ASPI), November 1997.

35 More detailed information on the individual country legislation can be found in the following

Insert Table 1 about here

3. The Economic Perspective

The economic purpose of the patent system is to provide incentives for innovation by allowing the patentee to control the use of the patented technology for a limited period of time. The social gains derived from these incentives and the patent system's disclosure function are weighed against the inefficiencies resulting from market power, cost of the patent system, and restrictions imposed on subsequent innovators.[36] The question of how to strike the optimal balance – in particular the issue of patent length and patent breadth – is complex.[37]

Incentives of a potential innovator would be aligned with those of a welfare-maximizing social planner if, first, the net surplus that the innovation creates was maximized (implying, among others, pricing at marginal cost), and second, the innovator was able to appropriate this surplus entirely. Obviously, this is a rather abstract goal, if only for the reason that the two conditions are contradictory: practical measures to ensure the innovator of the rewards of his/her work do increase incentives to innovate (dynamic efficiency), but usually decrease the surplus that the innovation creates (static inefficiency).

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references. Maloney (2000) for the U.S., Heath (2000) for Japan, Marshall (2000) for Germany, Cornish and Llewelyn for the UK, Petit (2000) for France, and Brinkhof (2000) for the Netherlands.

[36] See, e.g., Blair and Cotter (2001:45-46) and Henkel and von Hippel (2003).

[37] The economic analysis of incentives to innovate and the role of the patent system goes back at least to Arrow (1962), Nelson (1959), Nordhaus (1969), and Schmookler (1966). See Gallini and Scotchmer (2002) for a comprehensive discussion, and Grossman and Helpman (1991) in the context of economic growth. See Gilbert and Shapiro (1990) and Klemperer (1990) for an economic model assessing the effects of patent breadth.

To strike the optimal balance between these (and some further) counteracting effects is an issue not only for the design of patents, but also for the definition of indemnification rules. Legal scholars differ widely in their assessment of what damages would be optimal. There is support for indemnification beyond as well as below the losses incurred due to the infringement.[38] Economic scholars have shown that there are scenarios (static settings) under which "harm-based" liabilities are superior over "gain-based" ones (Polinsky and Shavell, 1994) from a welfare perspective.

We subscribe to the view that damages should at least cover the losses the innovator incurred due to infringement. While it is true that infringement may be *ex post* efficient[39], we think that the law of patent *granting* itself is better suited to take care of this trade-off than the subsequent stage of remedies for infringement.[40] That is, if some kind of infringement was

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38 Blair and Cotter (1998:1635-1636), as well as Pincus (1991:143), argue that damage awards should render the patent owner no worse off as a result of the infringement. Blair and Cotter add that they should render the infringer no better off. From the latter condition it follows that, if the infringer's profit is greater than the losses incurred by the patentee, then the latter is actually *ex post* better off with than without infringement (ignoring issues of uncertainty). In contrast, Ayres and Klemperer (1999: 1028-1031) put more weight on the welfare increase effected by a wider diffusion of the innovation, coming to the conclusion that social welfare would benefit if patent owners were awarded less than 100% of their losses.

39 Note that Polinsky and Shavell's (1994) results are derived from a static model.

40 This rationale is buttressed by Calabresi and Melamad (1972). If transactions costs are low, then property rights are more efficient than liability rights. For this paper this could mean the following: the innovation incentives are better set by the property right (patent) than by the liability rule (indemnification regulation) if the costs for state and inventors in deciding on the optimal protection given a certain invention are lower within the patent office than within the courts. Given the specialization of the patent office, this should be the case. More complicated considerations resulting

deemed beneficial by policy makers, then it should make sense to define the underlying patent more narrowly (thus defining an otherwise infringing act as a legitimate one). As to the potential infringer, we sympathize with the – admittedly more debatable – idea that infringement should not be profitable:[41] First, the potential infringer should have an incentive to negotiate for a license *ex ante* (i.e., before infringement) even though the remedy of the reasonable royalty introduces a virtual "renegotiation"; second, infringement should not become relatively more attractive than innovating. Otherwise, firms that would normally innovate if infringements were impossible might prefer to wait for a competitor to innovate, and then imitate its product by infringing on its patent. Just like diminished profits for the innovator, this free riding opportunity would reduce innovative activity.

In this paper, we focus on the implications that the existing rules have on incentives. To this end, we compare the damages awarded under the three principal legal rules to lost profits in the economic sense, meaning the difference between profits absent infringement and with infringement, no matter how these profits are realized.[42] They may come from usage of the patented technology in the innovator's own products and/or from licensing (or even selling) the patent. Economic lost profits are the natural benchmark if we assume that the patent

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from the current discussions of the performance of patent offices, the U.S. Patent Office in particular, are not considered in detail in this context.

41 See Blair and Cotter (1998), note 38, supra. See also Conley (1987:370).

42 Courts in the U.S. have recently made a first move towards such a comprehensive notion of lost profits (Blair and Cotter 2001, section I.C), a "but-for" causation standard. However, the legal utilization of the term "lost profits" poses a fundamental problem not only inherent in the U.S. jurisdiction but even more prominently in countries where case law plays a minor role (and legal constructs are not/less subject to judicial adjustments). Lost profits from a legal perspective are still commonly regarded as lost profits from the patentee's own production and strictly speaking do not cover damages that exceed this amount.

system, excluding infringement, is optimally designed. However, also without this assumption they are an obvious choice.

Lost profits as calculated by the courts ("legal lost profits") differ in general from the economic notion of lost profits ("economic lost profits"). "Legal lost profits" solely refer to those losses that stem from reduced output and/or reduced selling price of the patent holder; i.e., they are restricted to lost profits from the patentee's own production. In some countries (e.g., the U.K.), a combination of this indemnification rule with a license analogy is possible in cases where the infringer's output surpasses the patent holder's reduction in output. This is particularly relevant when the patent holder's capacity is constrained. However, in most practical situations, a combination of two indemnification rules makes the legal procedure too onerous for the plaintiff, so that one would rather claim a licensing fee for the infringer's complete output.

An ordinary license fee in the legal sense may reflect the actual economic damage fairly well in cases where the patent holder would have licensed the patent anyway. This may be particularly relevant in cases where a small firm would have licensed a patent to a larger firm. From an economic perspective, if the patent holder and a potential licensee negotiate a (lump-sum) licensing fee, then the patent holder will demand at least its (economic) lost profits from alternative ways of exploitation, while the licensee will pay at most the additional profits he/she can realize by using the patented technology.[43] Hence, when, due to the infringement,

[43] This supposes that production and sales take place both in case of a licensing agreement and infringement, which is realistic for a one-off licensing fee. When the negotiators agree on a per-unit fee, the licensee's marginal costs are increased, with a likely negative effect on its output compared to the case of infringement.

Note that at first sight this result seems to be at odds with Che and Chung's (1999) who find that for

the infringer gains less than the patentee loses, licensing would make no sense economically. In such a case, the legal and economic notions of licensing fees must diverge.

Finally, the legal notion of the infringer's profit may differ considerably from the (economic) lost profits. E.g., infringer's profits will be much larger when the infringer's market entry leads to a strong expansion of total output without too much margin reduction. This is likely to be the case when the holder is severely capacity-constrained. Infringer's profits will come close to the (economic) lost profit of the patent holder when the infringement basically leaves market size and prices unchanged and scale economies can be neglected, or when the effects of market expansion and margin reduction cancel each other out.

The size of the various profit measures depends on various factors, among the most important the following: the competitive pattern of the industry (particularly the capacity/size of the inventor and its competitors), the demand for the patent protected product or process, the effect of the underlying technology on production costs, and the degree to which the protected technology substitutes or complements existing products and processes.

The above is not to say, however, that calculating the different profit quantities is obvious. Consider, e.g., infringer's profits. For an economist, this quantity refers to the difference between profits with and without usage of the patented technology. While the definition

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possible renegotiation after "breach of contract" (here: infringement) the optimal compensation (reliance damage) lies between expected damages and liquidated damages. Contrary to Che and Chung (1999), our paper argues that a reasonably "expectable" indemnification is optimal for patent infringements. However, in our model the two parties (innovator and infringer) can bilaterally anticipate the bargaining result in the case of the "renegotiation" (here: reasonable royalty from an economic perspective awarded in trial).

sounds simple, problems arise in the attribution of overhead cost. How great really is the additional profit the infringer realizes due to its use of the patented technology when a reasonable share of overhead cost is attributed to the infringing product?[44] In some countries, these considerations are mirrored in legal rules (e.g., Table 1, "Infringer's profits," in the case of Germany).

4. Infringement Rules and Market Characteristics – A Model

In order to illustrate the economic implications of different indemnification rules for patent infringement we apply a very simple microeconomic model. We have made a number of simplifying assumptions to keep the model tractable and transparent.[45] Still, the model allows us to illustrate the fundamental theoretical considerations in a very concise fashion. As the base case, consider a monopolistic firm selling a single product. This product is based on a technology patented by the manufacturer. We have assumed that fixed as well as variable cost of production are zero. We also make the standard assumption of a single market interaction and do not model changes in output or external parameters over time. Market demand and profit functions are modeled in the following (standard) way:[46]

$$P(Q) = 1 - Q \tag{1}$$

$$\Pi_1^{Mon}(Q) = Q(1-Q) \tag{2}$$

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44 A corresponding question can be asked for the patent holder's lost profits: namely, if these are calculated with or without overhead cost attributed to the product.

45 We will critically reflect on the impact of these assumptions during our discussion and in the conclusions.

46 See, e.g., Tirole (1988:218).

Profit maximization leads to a monopoly output of $Q_1^{Mon} = 1/2$, with a resulting profit of $\Pi_1^{Mon} = 1/4$. Now assume that a second firm (the infringer) enters the market, also offering a product based on the patented technology. Firms compete in output quantities.[47] The two products are close substitutes, so that the simplifying assumption of a unique market price is justified. Given output quantities Q_1, Q_2, market price P and firms' profits Π_1^{Duop}, Π_2^{Duop} obtain as (i = 1, 2)

$$P(Q_1, Q_2) = 1 - Q_1 - Q_2 \quad , \tag{3}$$

$$\Pi_i^{Duop}(Q_1, Q_2) = Q_i(1 - Q_1 - Q_2) \quad . \tag{4}$$

In a duopoly, firm i's reaction function, its best response to firm j's output decision Q_j, is given by $R_i(Q_j) = (1 - Q_j)/2$. In equilibrium, the well-known result is that each firm produces $Q_i^{Duop} = 1/3$ and earns profits of $\Pi_i^{Duop} = 1/9$. Hence, total profits in this standard Cournot duopoly without capacity constraints are smaller than in monopoly, which is intuitive in the long run when the monopolist can build whatever capacity it requires. This implies that the profits of the second firm (the infringer) are always lower than firm 1's (legal) lost profits.

In the short run, however, it may well be that capacity restrictions prevent the patent holder from serving the whole market, and that total profits are higher in duopoly than in monopoly. In this case, infringer's profits will be larger than the patent holder's lost profits. Hence, for a comprehensive analysis of different infringement scenarios it is crucial to consider various

[47] Competition in quantities (Cournot competition) is a sensible assumption given that we include capacity constraints in our analysis. Furthermore, Kreps and Scheinkman (1983) could show that, under some assumptions, capacity precommitment followed by price competition yields Cournot outcomes, thus giving a very lucid interpretation of competition in quantities.

cases of capacity-constrained firms, which implicitly model different competitive scenarios. Severe capacity constraints imply that the second firm's entry reduces market price only slightly (see equation (3)). The incumbent's output remains unchanged, and its profits are only slightly diminished. Hence, competition in this case is low. In the other extreme, without binding capacity restrictions, both market price and the patent holder's equilibrium output are strongly affected – competition is strong.

The calculation of Nash equilibria in the presence of capacity constraints, with capacity K_i for firm i, is straightforward,[48] based on the reaction functions

$$R_i(Q_j) = \begin{cases} (1-Q_j)/2 & : K_i > (1-Q_j)/2 \\ K_i & : K_i \le (1-Q_j)/2 \end{cases} . \qquad (5)$$

This allows identifying those areas in K_1-K_2 parameter space where one or both firms operate at their capacity limit. In Table 2, we describe in detail the Nash equilibria and the corresponding profits for all parameter areas. What is important here is that both firms' profits in duopoly (excluding indemnifications for the moment) can be described as functions $\Pi_i^{Duop}(K_1, K_2)$ of the capacities K_i. From these quantities, net profits under different indemnification rules (assuming detection of the infringement and conviction of the infringer) can be calculated in the way shown in Table 3.

[48] In the case of price competition under capacity constraints, existence of a pure strategy equilibrium is not guaranteed (Levitan and Shubik, 1972). The case of quantity competition considered here does not pose this problem.

Insert Table 2 about here

Insert Table 3 about here

Using the profit functions $\Pi_i^{Duop}(K_1, K_2)$ given in Table 2 and the relations from Table 3, we calculate the relevant profit measures for both firms under different capacity combinations. This allows us to compare the incentives under different indemnification rules for varying competitive scenarios, described by capacity constraints. For illustration, we keep firm 1's capacity constant while varying K_2. In Figure 1, firm 1's capacity is fixed at $K_1 = 0.1$ (i.e., it is "small" compared to the monopoly output of 0.5), while in Figure 2, K_1 is "large" ($K_1 = 0.6$). In all cases, profits are shown as multiples of the respective monopoly profit, since we are interested in the relative size of the different profit quantities. The patent holder's profit curves are shown as full lines, those of the infringer as broken lines.

Each of the two figures depicts the following cases: a) duopoly without indemnification (or, equivalently, operative profits before payment of damages); b) net profits after "legal lost profits" have been awarded to the patent holder (which, for the latter, implies the original monopoly profits, hence a curve (b1) that is constantly equal to 1); and c) net profits after "infringer's profits" have been awarded to the patentee (in which case the infringer's net profit equals zero, curve c2). Figure 3 shows a close view of two symmetric cases (with the case of two small firms on the left hand side, and two large firms on the right hand side). When the patentee is strongly capacity-constrained (Figure 1), total duopoly profits are above monopoly profits, and a voluntary licensing agreement would be feasible. Hence, Figure 1 additionally shows profit curves for the hypothetical case of a voluntary payment of royalties (curves d1, d2; we assume for simplicity that the profit increase in duopoly compared to monopoly is split equally between the two firms, see below). Since such licensing would

increase the patent holder's profits as compared to a monopoly, these curves are important benchmarks when discussing the economic lost profit and the innovator's incentives. Figure 3 shows a close-up of two symmetric capacity scenarios (both firms small, both firms large).

In the following section, the model results will be interpreted with respect to innovation and imitation incentives.

5. Discussion

We now employ the model developed above to discuss the lead question of our article, namely to what extent existing patent indemnification rules affect incentives for innovation and imitation. To do so we initially compare the profits of patent holders (innovators) and infringers (imitators) along the different generic damage award regulations for the two scenarios of a small and a large patent holder. For both scenarios, we consider different sizes of the infringer. Eventually, these comparisons will reveal how an optimal liability rule could look like. In a second and third step, we deepen the discussion in more detail to elucidate policy implications in the light of national juridical idiosyncrasies.

5.1. Incentives for Innovators and Imitators – Towards a General Indemnification Rule

Discussing incentives for innovation and imitation is not necessarily the same as discussing incentives for patenting and infringing patents. Thus, the discussion starts with another simplifying assumption, namely that we consider strong appropriability regimes in which innovation is most likely accompanied by legal protection in the form of patenting. Furthermore, when considering the incentive distortions of infringement on innovation it is not trivial to find a feasible point of reference for the discussion of profits. Plausibly, one might refer to the attractiveness of innovation for the patent holder absent the risk of

infringement. In a classical setting (one product firm holding a discrete patent-protected technology) those profits would be the monopoly profits of the patent holder from in-house production. Introducing capacity constraints alters the discussion, though. From an economic perspective, the anticipated profits of a capacity-constrained firm may exceed simple monopoly profits from in-house production because it might be feasible for the firm to choose a superior mix of in-house production and non-exclusive voluntary licensing. The latter part of the firm's profit function would then depend on its anticipated negotiation outcome with a potential licensee which again would depend on the licensee's anticipated profits, the holder's bargaining power, etc. Without going into further detail, it becomes obvious that determining the anticipated profits of a capacity-constrained innovator in a general fashion requires further assumptions.[49] To model 'realistic' innovation incentives by capacity-constrained firms would require to formally introduce the innovator's and the infringer's bargaining power before infringement. The latter would presumably depend again on various factors such as firms' capacities and the competitive scenario. At this point, however, we fear that the potential benefits from including bargaining power as an additional factor into a more sophisticated model are outweighed by the disadvantages from the dilution of the key findings of this article. Thus, for the purpose of this paper, we make another simplification. In the following we assume that the innovator and infringer would dispose of equal bargaining power when negotiating a legal license before infringement takes place.[50] Thus, for the cases in which an

[49] This is true even for our simple model. In real economic life, further complications in finding thecorrect point of reference arise: For example, the plaintiff might claim lost sales of unpatented items and spare parts (Blair and Cotter, 2001:29). In addition to these conceptual problems, grave measurement difficulties exist (see, e.g., Pincus, 1991).

[50] An obvious alternative simplification would relate the bargaining power to the capacity. Note, however, that such an approach may be at odds with reality. Consider the case where a small biotechnology corporation owns a patent and there are two potential large corporations interested in the

innovator's incentives to innovate are co-determined by his/her anticipated returns from royalties additional to his/her own in-house production – namely the cases of small innovators – we assume that the patent holder's incentives to innovate are determined by his/her monopoly profits from in-house production plus half of the additional profits made in the legal duopoly case (when the patent gets legitimately licensed to a second corporation).[51]

a. The case of small patent holders

Figure 1 illustrates the patent holder's initial incentives to innovate (curve d1) and the infringer's incentives to imitate (curve d2) in our simple model for the case of a small patent holder (assuming that conviction of the infringer is certain, and that both players know about this; see below for a discussion) and different capacities of the infringer.[52] The symmetric case of two small (capacity-constrained) firms is indicated by an arrow at the horizontal axis (Figure 3, left, provides a close-up of this case as a 'snapshots' along the vertical axis). It becomes obvious that innovation incentives vary tremendously depending on the relevant indemnification rules. A rule awarding solely lost profits from the patentee's own production will lead to a reduction of the innovator's incentives by the threat of infringement, since the attainable profits (curve d1) including voluntary royalties are larger (much larger if the infringer is a large firm) than firm 1's net profits after being awarded (legal) lost profits

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commercialization of the invention. In this case, the sheer capacity ration of the potential licensee to the licensor firm does not correctly reflect the patent owner.

[51] Note: In the duopoly case the patent holder will no longer earn monopoly profits from in-house production. Due to his equal bargaining power he/she will, however, claim more than half of total the duopoly profits, namely half of the *additional* profits in the duopoly case compared to the monopoly case.

[52] It is interesting to note that, up to a capacity of $K_2 = 0.44$ of the infringer, the patent holder operates at his/her capacity limit. Hence, there is no harm done in terms of units sold; the patent holder's loss (curve a1 compared to curve b1) is entirely caused by the price erosion effect.

(curve b1). On the other hand, the small patent holder's incentives are vastly increased over his/her incentives absent infringement if he/she may expect to be awarded infringer's profits in the case of illegitimate imitation (c1), an effect that increases in the infringer's size. Looking at the imitation incentives for infringers in this scenario, we find that for any capacity of the infringer, imitation is profitable if all he/she has to fear is a verdict of lost profits according to current legal understanding (curve b2). But even if they had to fear a verdict that corresponds to an *economic* understanding of 'lost profits' there would remain incentives for imitation. Interestingly, in both cases incentives to imitate increase with rising capacity on the infringer's side.

b. The case of large patent holders

When large firms are infringed, total profits are smaller in a duopoly than in a monopoly. Consequently, licensing makes no sense and the innovator's profits from his/her own production serve as a benchmark (curve b1). As Figure 2 illustrates, the innovator's incentives remain undistorted if he/she can be sure that lost profits from own production are awarded. Since total duopoly profits are smaller than monopoly profits of the innovator, the latter will be better off by claiming lost profits. For the patent holder, this has the additional advantage that the infringer's net profit becomes negative, which might help to drive small imitators out of the market and to act more generally as a deterrent to imitation. As in Figure 1, the symmetric case is indicated by an arrow at the horizontal axis, and Figure 3, right, provides a close-up.

From a theoretical standpoint, the discussion in 5.1 allows to deduct the following fundamental insight (that will be discussed in more detail looking at various scenarios in 5.2): within our (fairly realistic) framework of assumptions the application of existing indemnification rules does not yield an optimal restitution outcome. However, one may doubt

that optimal liability rules proposed by the established literature would, either. In a static setting, a classic harm-based measure may not always be superior to a gain-based one as the gain can exceed the harm by far (see above, infringer's profits). In a dynamic setting, a harm-based measure would reduce innovation incentives for the future. As our analysis shows an optimal liability regulation could, however, be an expectation damage rule based on a renegotiation outcome from an *ex-ante* perspective (falling in between the generic legal notions of 'lost profits' and 'infringer's profits') between licensor and licensee. While the reasonable royalty regulation provided by most national laws could theoretically accommodate such a rule, its institutionalized character as a fall-back option in the canon of liabilities makes it impossible: a reasonable royalty with lost profits as the upper bound is not suited to restore incentives.[53]

5.2. Infringement and Restitution Scenarios in Different Jurisdictions

Going into more detail and recalling the two infringement scenarios developed in 5.1, we consider the infringement of small corporations by large competitors the most interesting case. By our definition, incentives for innovators function uninhibitedly only if they are awarded economic lost profits (curve d1, Figure 1). Lost profits in the legal sense, however, certainly do not reflect the real incentives for the innovator in these particular cases. This is because of two opposing reasons. At first the relative litigation costs are higher for the small innovator than for the large imitator. Thus, the likelihood for the innovator to enforce his right and enjoy damage awards is reduced. Secondly, however, the small patent holder's incentives are vastly increased over his/her monopoly profits from in-house production if he/she may expect to close a legitimate license deal with a large competitor even before infringement takes place. Thus, from an economic standpoint a suitable indemnification rule must award a reasonable royalty rate to prevent an undesired reduction of innovation incentives. A quick

[53] The next paragraph will elaborate more on this last finding.

look at Table 1 confirms that all the jurisdictions analyzed in this paper provide the plaintiff with the option to claim a reasonable royalty rate. Thus, in principle the law provides sufficient remedies to avoid innovation disincentives. As argued above, however, this reasonable royalty would have to exceed the amount of 'lost profits' in a legal sense. In practice, the latter is still virtually never the case.

However, in particular cases existing regulations may also lead to an undesired *elevation* of incentives for innovators to be infringed rather than to stipulate legitimate license deals with competitors in the first place. If small patent holders can theoretically anticipate to be awarded infringer's profits, this may lead to unwanted results from a welfare standpoint, in particular given the apportionment problem.[54] In the extreme case, it may well be that the plaintiff is awarded more than the total societal value of its innovation, which obviously implies an inefficiency from a welfare point of view.

Let us illustrate our last point by analyzing the introductory cases in the light of our theoretical analysis. Turning back to the respective questions posed initially one may at least question whether Lemelson would have gained US$ 25 million if he had produced the truck toy himself. A hypothetical royalty rate negotiated *ex-ante* between the parties – a sensible measure for Lemelson's economic lost profits – would likely have been lower than the rate of 4.5% awarded *ex-post* by the court. While this ruling is made complicated by a certain penal element, it demonstrates nonetheless that small patent holders might be overcompensated, and even heavily so. This again results in an undesired distortion of innovation incentives.

It's also questionable whether the SquareD corporation would have agreed to pay US$ 13.2 million for the database technology in a negotiation before infringement with Mr. and Ms. Calabrese and whether a market-based royalty does not overcompensate the plaintiff. Note that these verdicts were filed in the US, that means in a country in which the maximum payment to be feared by inadvertent infringers are royalty fees or lost profits from own

[54] See Blair and Cotter (2001:14).

production. In Germany, the Netherlands, and Japan those damage award sums could theoretically be even higher when calculated according to the infringer's profits regulation (depending on the infringer's capacity).

To judge whether and how innovators should be entitled to profits exceeding lost profits or a reasonable royalty rate, yet another consideration needs to enter this discussion. This aspect refers to the difference between patent systems that disclose information about pending applications and those which do not. We argue that until most recently there were good reasons for the U.S. not to impose additional threats to imitators by awarding infringer's profits to innovators due to the lack of disclosure of patent information before grant. This would have set undesired incentives for being infringed. In systems, however, where patent information is disclosed before grant (all of the systems we analyzed, including the current U.S. system) the disadvantages of rules exceeding legal lost profits or reasonable royalties should be minor and the positive effects of the infringer's profits regulation may dominate. Consequently, pending an economically more suitable definition of 'lost profits' in the law, we currently favor Germany's and Japan's approach of awarding infringers' profits after patent grant over the only elevated thread posed by the US system, namely multiple royalties in the case of willful infringement.[55]

We favor the German and Japanese regulation over the U.S. regulation of awarding multiple royalties not least because of dogmatic consistency: The discussion so far was restricted to damage payments from the infringer to the patent holder. In cases where total profits are increased due to the infringement (Figure 1), it should be preferable from a welfare standpoint to allocate part of the additional profit to the public, in order to restore innovation and imitation incentives to what they were if infringement could be excluded *ex ante.* Thus, a

[55] The constraint of awarding infringer's profits only *after* grant appears optimal since it eliminates the undesired possibility that small innovators block large competitors with low quality applications that have little likelihood of being granted.

public interest is touched and hence public law (including penal law) could in principle become relevant. Consequently, the US regulation appears consistent at first sight. To justify the introduction of a penal element into private procedural law – as is the case when awarding multiple royalty rates because of 'willful infringement' – however, damage awards would have to be allocated partly to the public and not only to the plaintiff. Tentatively, however, it appears to us that the U.S. regulation on 'willful infringement' in practice is often applied as a partial substitute for the non-existent remedy awarding infringer's profits – none of the profits are allocated to the public but all goes to the plaintiff. If this was true, however, we would argue that the dogmatically problematic introduction of a penal element into civil legal procedures to reduce large corporations' incentives to weaken small innovators is unnecessary and thus undesired.

The case of small firms being infringed is also insightful when looking at capacity-constrained infringers. Again it is obvious from Figure 1 that a regulation for the award of lost profits in the legal sense would not restore all of the patent holder's incentives to innovate *ex-ante*. In a regime of constrained capacities ($0 < K_{1,2} < 0.33$) lost profits in an economic sense lie in between infringer's profits and lost profits in the legal sense. Thus, neither of the existing rules is ultimately satisfying. From a welfare standpoint, however, in this particular regime we see good arguments to offer infringer's profits to the plaintiff who could in this way be overcompensated for his/her risk during the development of the initial innovation and the enforcement of the patent. The fact that imitators have certain incentives for infringement is more difficult to judge. As Figure 1 illustrates, infringing on a small patent holder may still be profitable if all the infringer has to fear is a verdict on lost profits (both in the legal and in the economic sense). We find it difficult to tell whether this is undesirable or not. The sole production of a good by one capacity-constrained innovator is inefficient in itself because too few consumers can profit from the invention. Thus, the question remains whether the

capacity-constrained patent holder would have licensed his patent in an efficient way in the absence of infringement. If so, then imitation would be undesirable and economists might – in the absence of a lost profit rule in the economic sense – favor a verdict based on infringer's profits over a verdict based on lost profits in the legal sense. If not, imitation might even increase overall welfare, provided the negative effect on incentives to innovate is not too great. In turn, the question arises if a potential infringer would have sought to obtain a license from the capacity constraint patent holder if all he/she had to fear in case of conviction was a verdict on economic lost profits, i.e., on the same amount that he/she would have had to pay for an ex-ante license. If the likelihood of conviction is sufficiently high, then seeking a license ex-ante should be preferable because of lower transaction and reputational cost. If the likelihood is low, then the damage awards should be such that *expected* awards – taking the likelihood of conviction into account – equal economic lost profits.

Finally we reconsider the case when large firms are imitated (Figure 2). Here we find that the existing national laws provide sufficient opportunities to create efficiency, since in this particular case lost profits in the legal sense match economic lost profits. In addition, the fact that the infringer's final payoff becomes negative after restitution of legal lost profits provides a disincentive to imitate.

5.3. Legal Policy Implications

This discussion shows that various arguments can be examined and that no single solution may be optimal for all potential innovation and infringement scenarios. Obviously, policy makers and managers need to consider which scenarios are most relevant for each individual case.[56] Despite limitations, however, we feel that the above analysis enables us to draw

[56] The discussion did not explicitly include cost considerations for innovation – an aspect that remains to

various conclusions. In the following we seek to provide policy makers with information we consider relevant for making design changes to patent indemnification rules.

At first, we consider it inevitable for legal systems to align lawyers' and economists' notions of lost profits.[57] The dissonance between the two was a driving factor for writing the paper, and the analysis of parts two, three, and four have shown that it is no mean task to come up with a taxonomy that shows the relation between legal and economic terms. Despite the simplification we ourselves made in part 5.1 for illustrative purposes, in general we argue that lost profits can neither be defined as lost profits from in-house production nor as a combination of hypothetical losses from in-house production and a *standard* licensing fee. Rather, lost profits should reflect an optimal mix of lost profits from in-house production and realistic licensing revenues from a patent holder's perspective. These profits for the holder will be determined by his/her capacities, the capacities of his/her competitors, and the bargaining power of the two parties. Thus, ultimately, what current regulations acknowledge as *infringers' profits* represents one end of the range of *potentially lost profits* in an economic sense (this applies when all bargaining power lies with the patent holder). From an economic perspective, therefore, we do not see any reason why U.S. and French law cannot award

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be elaborated on in the future. Moreover, we did not explicitly model duration effects; i.e., for how long did the infringement take place. Oftentimes – this is what we were told by practitioners – for large corporations preliminary injunctions of cease and desist are the most important legal remedies to avoid severe losses (see Lanjouw and Lerner, 2001, for a respective study. See also Hall and Ham Ziedonis , 2001, for the discussion of the "shut down value" of injunctions). The *ex-post* calculation of the damages themselves may be secondary. Finally, we could only pinpoint the most important practical considerations concerning the implementation of economically sensible indemnification rules, such as burden-of-proof issues or doctrinal consistency with other parts of national law that might be affected.

[57] See also Schankermann and Scotchmer (2001) who come to the same conclusion that the reasonable royalty doctrine is only consistent with an economic understanding of damage awards in certain scenarios.

infringer's profits as damages and why German and the Dutch law can award infringer's profits only by applying the so-called 'business on behalf of the owner' in an analogous way – a legal construct that seeks to reimburse the patent holder without calling a spade a spade. On the other hand, it seems natural to us – and actually overdue – that the first cases from the U.K. have been reported in which lost profits from the patentee's own production and additional licensing fees exceeding the lost profits are combined in one claim.

Secondly, we find that the choice for plaintiffs to choose among various forms of damage award calculations within one case may not always be desirable from a welfare standpoint.

Although limited to cases of patent infringement, the above analysis also bears relevancy for the calculation of damages where other intellectual property rights such as copyrights or trademarks are infringed. As such, the analysis is part of the much broader question of appropriate allocation of economic gains on the basis of certain legal positions, be it intellectual property rights or other competitive advantages.

6. Summary and Outlook on Future Research

This paper started from the premise that patent indemnification rules significantly affect innovation incentives for (future) patent holders and imitation incentives for (potential) infringers. Comparing existing patent damage award regulations of six different countries we came to the surprising insight that within and across various jurisdictions damage calculation regulations can be applied in parallel within one case. We illustrated that the parallel existence of three generic rules – namely lost profits, infringer's profits, and ordinary licensing fees – combined with the plaintiff's freedom of choice for either one of them leads to distortions from desired innovation incentives through patents, especially if innovators are capacity-constrained. Using a Cournot model of two capacity-constrained firms, one innovator and one (illegitimate) imitator, we could identify various scenarios in which existing regulations allow opportunistic behavior by either one of the parties involved. The analysis revealed that lost

profits in a legal sense cannot restitute innovator's incentives in capacity-constrained regimes. On the other hand, infringer's profits can set unwanted incentives for imitating small firms. Our findings make a theoretical contribution and call for a juridical debate.

As we could show in the paper, there is no clear superiority of "harm"-based over "gain"-based indemnification measures in the classical sense in the field of patent law, not even from a purely static perspective as there exist scenarios in which the gain significantly exceeds the harm (large corporations infringing capacity-constrained corporations). In a dynamic setting, the distinction between "harm"- and "gain"-based liabilities in the field of patent law cannot be made very sharply any more because the patentee's lost profits and the infringer's profits are strongly correlated if one assumes that in many scenarios the socially desired outcome would be a licensing agreement between innovator and infringer.[58] This "renegotiation" possibility theoretically offered by the patent law's indemnification in the form of the reasonable royalty remedy is a feature that the patent indemnifications share with contracts on co-operative investments even though the results on the optimality of liability results are not directly transferable. However, the dogmatic institutionalization of the reasonable royalty as a fall-back option (yielding systematically lower indemnifications sums than lost profits or infringer's profits) dilutes its theoretical claim in the canon of liability rules.

In our eyes, legal policy makers across countries face multiple challenges reforming patent indemnification rules. Given the possibilities of opportunistic behavior awarded to plaintiffs as a result of their freedom to choose a certain type of calculation method within one case, we think that courts rather than plaintiffs should decide which regulations they want to apply in a case. While this last step could be taken in the short run, the dogmatic implementation of an overall suited liability rule poses a challenge for the future.

[58] At least in a dynamic setting (see above).

Finally, the paper offers ample opportunity for future study. First, it might be interesting to introduce bargaining power into the model and analyze how the competitive situation of the patent holder and infringer affects the incentives for innovation and imitation conveyed by the different indemnification rules. Second, duration effects could be considered and cost considerations for innovation and imitation could be modeled more explicitly. Moreover, we would find it most interesting to extend this analysis to other fields of law in which indemnification rules play a role and to examine the broader applicability of our results.

References

Arrow, K. J. 1962. "Economic Welfare and the Allocation of Resources for Invention," in: R. Nelson (ed.), The Rate and Direction of Inventive Activity, Princeton University Press, Princeton (NJ).

Assmann, H.-D. 1985. "Schadensersatz in mehrfacher Höhe des Schadens," Betriebs-Berater 15-25.

Ayres, I. and P. Klemperer. 1999. "Limiting Patentees' Market Power Without Reducing Innovation Incentives: The Perverse Benefits of Uncertainty and Non-Injunctive Remedies," 97 Michigan Law Review 985.

Bebchuck, L.A. and I.P.L. Png. 1999. "Damage Measures for Inadvertant Breach of Contract," 19 International Review of Law and Economics 319-331.

Bebchuck, L.A. 2001. "Property Rights and Liability Rules: The Ex-Ante View of the Cathedral," John M. Olin Discussion Paper Series #347.

Blair, R. D. and T. F. Cotter, 1998. "An Economic Analysis of Damages Rules in Intellectual Property Law," 39 William and Mary Law Review 1585-1694.

Blair, R. D. and T. F. Cotter. 2001. "Rethinking Patent Damages," 10 Texas Intellectual Property Law Journal 1-93.

Brinkhof, J. 2000. "The Enforcement of Patent Rights in the Netherlands," 31 International

Review of Intellectual Property and Copyright Law 706-722.

Calabresi, G. and A.D. Melamed. 1972. "Property Rules, Liability Rules, and Inalienability: One View of the Cathedral," 85 Harvard Law Review 1089-1182.

Casucci, G. 2000. "The Enforcement of Patent Rights in Italy," 31 International Review of Intellectual Property and Copyright Law 692-705.

Che, Y.-K. and T.-J. Chung. 1999. "Contract Damages and Co-operative Investments", 30 RAND Journal of Economics 84-105.

Conley, N. L. 1987. "An Economic Approach to Patent Damages," 15 American Intellectual Property Law Association Quarterly Journal 354-390.

Cornish, W. and D. Llewelyn. 2000. "The Enforcement of Patents in the United Kingdom," 31 International Review of Intellectual Property and Copyright Law 627-645.

Gallini, N. and S. Scotchmer. 2002. "Intellectual Property: When Is It the Best Incentive System?," in: Innovation Policy and the Economy, Vol. 2, Jaffe, A., J. Lerner, and S. Stern, eds., Cambridge (Mass.): MIT Press,

Gilbert, R. and C. Shapiro. 1990. "Optimal Patent Length and Breadth," 21 RAND Journal of Economics 106-112.

Grossman, G. and E. Helpman. 1991. Innovation and Growth in the Global Economy, Cambridge (Mass.): MIT Press.

Hall, B. and R. Ham Ziedonis. 2001. "The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995," 32 Rand Journal of Economics 101-128.

Harhoff, D. and M. Reitzig. 2001. "Determinants of Opposition Against EPO Patent Grants: The Case of Pharmaceuticals and Biotechnology," CEPR WP 3645.

Heath, C. 2000. "The Enforcement of Patent Rights in Japan," 31 International Review of Intellectual Property and Copyright Law 749-770.

Heil, U. and M. Roos. 1994. "Zur dreifachen Schadensberechnung bei Übernahme sonderrechtlich nicht geschützer Leistungen," Gewerblicher Rechtsschutz und Urheberrecht 26-31.

Henkel, J. and E. von Hippel. 2003. "Welfare Aspects of User Innovation," *working paper*, MIT Sloan School of Management, Cambridge (Mass.).

Kaplow, L. and S. Shavell. 1996. "Property Rules Versus Liability Rules: An Economic Analysis," 109 Harvard Law Review 713-790.

Karnell, G. 1996. "Gedanken zur Bemessung von Schadensersatzansprüchen bei Patentverletzungen," Gerwerblicher Rechtsschutz und Urheberrecht 335-345.

Klemperer, P. 1990. "How Broad Should the Scope of Patent Protection Be?," 21 RAND Journal of Economics 113-130.

Kreps, D. M. and J. A. Scheinkman. 1983. "Quantity Precommitment and Bertrand Competition Yield Cournot Outcomes," 14 Bell Journal of Economics 326-337.

Lanjouw, J. O. 1998. "Patent Protection in the Shadow of Infringement: Simulation Estimations of Patent Value," 65 Review of Economic Studies 671-710.

Lanjouw, J. O. and M. Schankerman. 2001. "Characteristics of Patent Litigation: A Window on Competition," 32 RAND Journal of Economics 129-51.

Lanjouw, J. O. and J. Lerner. 2001. "Tilting the Table? The Predatory Use of Preliminary Injunctions," XLIV The Journal of Law and Economics 573-603

Lehmann, M. 1988. "Juristisch-ökonomische Kriterien zur Berechnung des Verletzergewinns bzw. des entgangenen Gewinns," 25 Betriebs-Berater 1680-1687.

Levitan, R. and M. Shubik. 1972. "Price Duopoly and Capacity Constraints," 13 International Economic Review 111–122.

Maloney, D. 2000. "The Enforcement of Patent Rights in the United States," 31 International Review of Intellectual Property and Copyright Law 723-748.

Marshall, H. 2000. "The Enforcement of Patent Rights in Germany," 31 International Review of Industrial Property and Copyright Law 646-676.

Melville, D. W. 1999. "Liability Rules, Property Rules, and Incentives Not to Bargain: The Effect of Competitive Rivalry on the Protection of Legal Entitlements," 29 Seton Hall Law Review 1277-1297.

Nelson, R. 1959. "The Simple Economics of Basic Research," 67 Journal of Political Economy 297-306.

Nordhaus, W. D. 1969. Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change, Cambridge (Mass): MIT Press.

Petit, L. 2000. "The Enforcement of Patent Rights in France," 31 International Review of Intellectual Property and Copyright Law 669-691.

Pincus, L. B. 1991. "The Computation of Damages in Patent Infringement Actions," Harvard Journal for Law & Technology Fall, 95-143.

Polinsky, A.M. and S. Shavell. 1994. "Should Liability Be Based on the Harm to the Victim or the Gain to the Injurer?," 10 Journal of Law, Economics, and Organization.

Schankerman, M. and S. Scotchmer. 2001. "Damages and Injunctions in the Protection of Intellectual Property," 32 RAND Journal of Economics Spring 199-200.

Schmookler, J. 1966. Invention and Economic Growth, Cambridge (Mass.): Harvard University Press.

Schweizer, U. 2003. "Cooperative Investments Induced by Contract Law", *working paper*, University of Bonn.

Tirole, Jean. 1988. "The Theory of Industrial Organization, Cambridge (Mass.): MIT Press.

Vollrath, U. 1983. "Zur Berücksichtigung der Entwicklungs- und Schutzrechtskosten bei der Bemessung der Schadenersatz-Lizenzgebühr für Patentverletzung," Gewerblicher Rechtsschutz und Urheberrecht, 52-56.

Tables and Illustrations

Table 1: Indemnification regulations within and across countries – an international comparison

Country	Lost Profits	Licensing Fee	Infringer's profits	Choice for plaintiff
U.S.	35 USC § 284. Requirements: (1) demand; (2) marketing capacity; (3) absence of competing, non-infringing substitutes.	Fall-back provision where lost profits cannot be or are not claimed.	No	Yes
Japan	Sec. 102(1) Patent Act: Multiplication of infringer's turnover with profits the patentee would have made for such number of products. Marketing capacity of patentee must be proven.	Sec. 102(3) Patent Act: fall-back provision; estimate of royalty rate.	Sec. 102(2) Patent Act. Not applicable where patent was not used by patentee.	Yes
Germany	Sec. 249 Civil Code: restitution of the *status quo ante*. Limitation by production capacity and proof that infringing product could act as a substitute.	Most common form of calculation, normally agreed upon in court settlement. No "infringer's surcharge" can be claimed except for copyright matter (double royalty).	Based on the legal fiction that infringer undertakes a business allocated to the patentee. Deduction of infringer's expenses. Infringer's marketing efforts taken into account.	Yes: claim for inspection of infringer's accounts allowed prior to choice of calculation base.
UK	Yes, likelihood of having made the infringer's sales, deduction of infringer's efforts to commercialize.	Yes, a notional royalty as the minimum of lost profits.	Yes, but rarely requested.	Yes, after review of the defendant's commercial documents .
France	Only if patent is used; calculated by amount of counterfeit products, loss of turnover (determined *inter alia* by the quality of the patent) and amount of lost profits. Market share of patentee considered.	Where the invention is not used. Infringer's turnover multiplied by an appropriate royalty rate.	No, clarified in Patent Act 1968.	If patent is actually used: Yes.
The Netherlands	Same as Germany. Sec. 42(2) Patent Act 1910, Sec. 70(3) Patent Act 1995.	Regarded as the minimum that can be claimed as lost profits.	Sec. 43(3) Patent Act 1910; Sec. 70(4) Patent Act 1995: the infringer should not be allowed to keep his profits.	Yes, after inspection of documents.

Table 3: Relation between basic duopoly profits and net profits under different indemnification rules for patentee and infringer

Indemnification rule	**Net profits firm 1 (patentee)**	**Net profits firm 2 (infringer)**
none	Π_1^{Duop}	Π_2^{Duop}
"lost profits"	Π_1^{Mon}	$\Pi_2^{Duop} - (\Pi_1^{Mon} - \Pi_1^{Duop})$
"infringer's profit"	$\Pi_1^{Duop} + \Pi_2^{Duop}$	0
voluntary royalty[59]	$(\Pi_1^{Duop} + \Pi_2^{Duop} + \Pi_1^{Mon})/2$	$(\Pi_1^{Duop} + \Pi_2^{Duop} - \Pi_1^{Mon})/2$

[59] This line is only relevant if total profits in duopoly are higher than monopoly profits.

Table 2: Nash equilibria in different areas of K_1-K_2 parameter space, corresponding to different competitive scenarios due to capacity constraints

Area in K_1-K_2 parameter space	Definition of area	Monopoly output Q_1^{Mon}	Monopoly profits Π_1^{Mon}	Duopoly output		Duopoly profits	
				firm 1, Q_1^{Duop}	firm 2, Q_2^{Duop}	firm 1, Π_1^{Duop}	firm 2, Π_2^{Duop}
A	$K_1 < \frac{1}{2}(1-K_2)$ $K_2 < \frac{1}{2}(1-K_1)$	K_1	$K_1(1-K_1)$	K_1	K_2	$K_1(1-K_1-K_2)$	$K_2(1-K_1-K_2)$
B	$\frac{1}{2}(1-K_2) < K_1 < \frac{1}{2}$ $K_2 < \frac{1}{3}$	K_1	$K_1(1-K_1)$	$\frac{1}{2}(1-K_2)$	K_2	$\frac{1}{4}(1-K_2)^2$	$\frac{1}{2}K_2(1-K_2)$
C	$K_1 > \frac{1}{2}$ $K_2 < \frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{2}(1-K_2)$	K_2	$\frac{1}{4}(1-K_2)^2$	$\frac{1}{2}K_2(1-K_2)$
D	$K_1 > \frac{1}{2}$ $K_2 > \frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{9}$	$\frac{1}{9}$
E	$\frac{1}{3} < K_1 < \frac{1}{2}$ $K_2 > \frac{1}{3}$	K_1	$K_1(1-K_1)$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{9}$	$\frac{1}{9}$
F	$K_1 < \frac{1}{3}$ $K_2 > \frac{1}{2}(1-K_1)$	K_1	$K_1(1-K_1)$	K_1	$\frac{1}{2}(1-K_1)$	$\frac{1}{2}K_1(1-K_1)$	$\frac{1}{4}(1-K_1)^2$

Figure 1: Net profits for patent holder and infringer under different indemnification rules. Case of small capacity of the patent holding firm 1 (K_1 = 0.1). Profits are given in multiples of firm 1's monopoly profits Π_1^{Mon}, as functions of firm 2's capacity K_2.

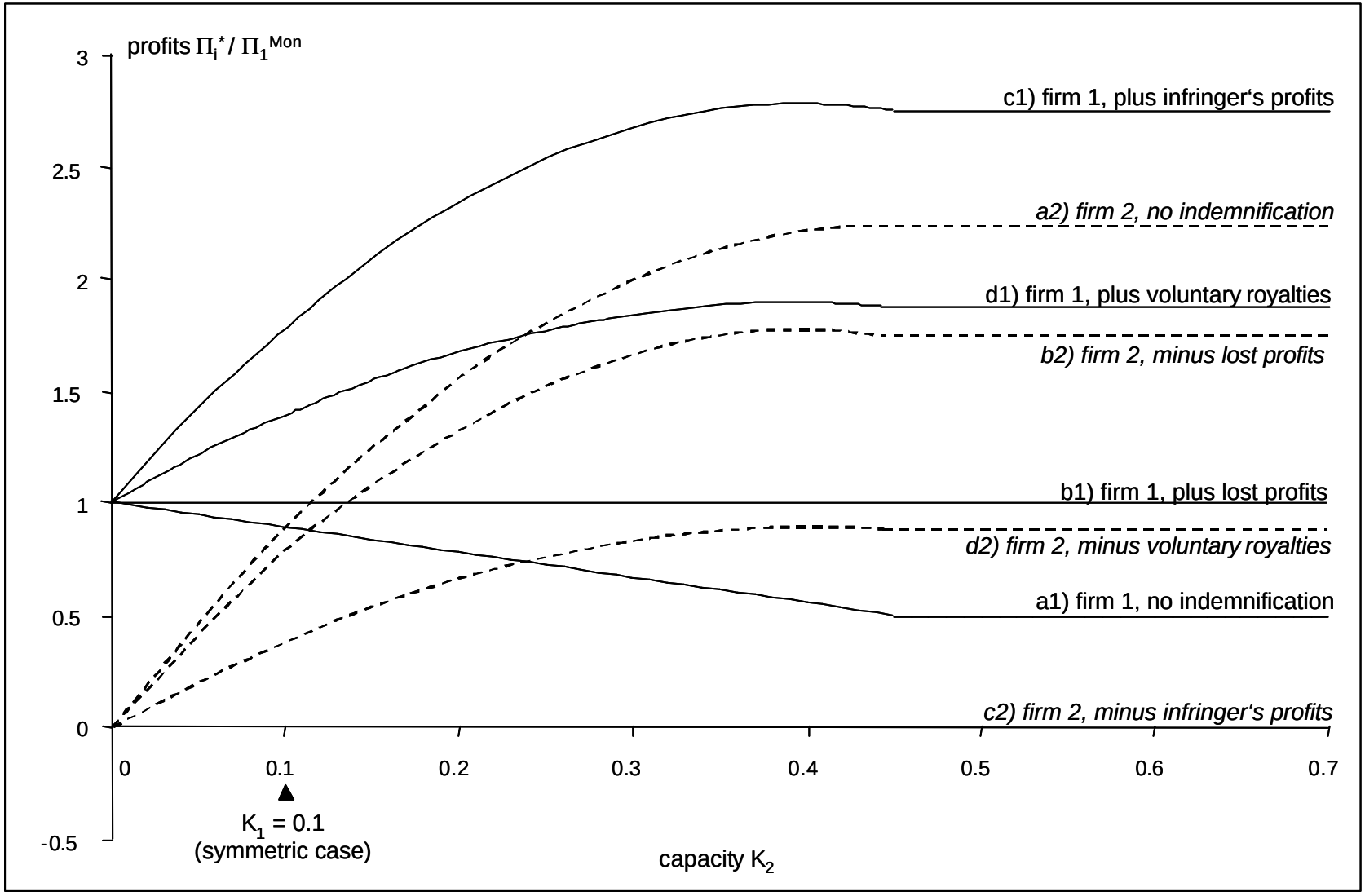

Figure 2: Net profits for patent holder and infringer under different indemnification rules. Case of large capacity of the patent holding firm 1 (K_1 = 0.6). Profits are given in multiples of firm 1's monopoly profits Π_1^{Mon}, as functions of firm 2's capacity K_2.

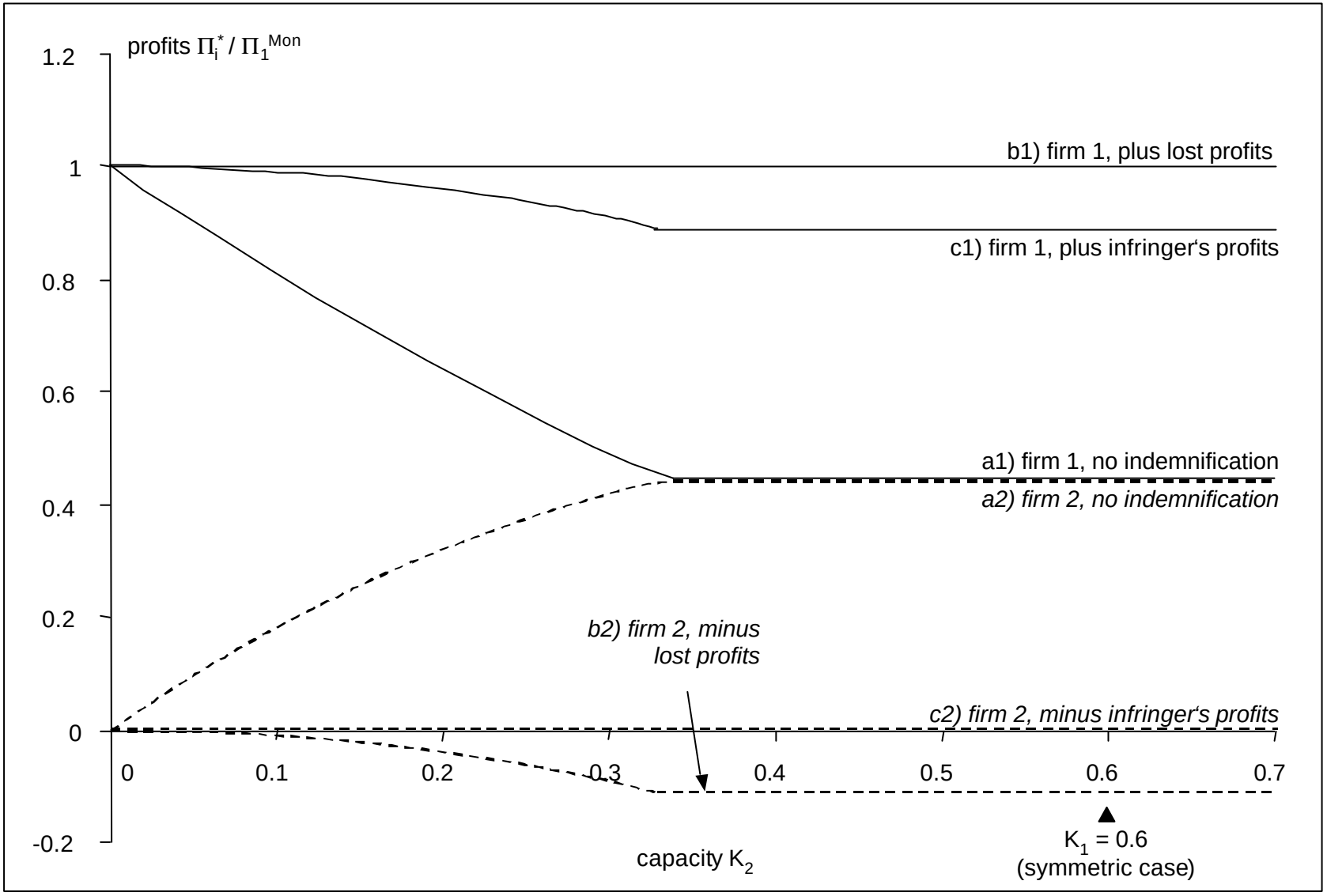

Figure 3: Profits for patent holder and infringer under different indemnification rules, for the case of identical capacities. Left: $K_1 = K_2 = 0.1$ („small“); right: $K_1 = K_2 = 0.6$ („large“). Profits are given in multiples of firm 1‘s monopoly profits Π_1^{Mon}.