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Henrik Horn

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Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

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JEL Classification: F15, K21, K33, L40, O38

Keywords: Standard-essential patents, international jurisdiction, Default rules

Henrik Horn - henrik.horn@econ-law.se
Research Institute of Industrial Economics (IFN) and CEPR

INTERNATIONAL JURISDICTION OVER STANDARD-ESSENTIAL PATENTS

Henrik Horn[1]
The Research Institute of Industrial Economics (IFN), Stockholm
Bruegel, Brussels
Centre for Economic Policy Research, London

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Abstract

A sizeable literature analyzes the appropriate interpretation of FRAND commitments for standard-essential patents. With few exceptions, the literature disregards international dimensions, despite the fact that most standards are used in international markets. This paper uses a simple economic setting to assess pros and cons of the main jurisdictional bases in international law—the Territoriality and Nationality Principles—when national regulatory authorities have conflicting preferences regarding the interpretation of FRAND commitments. The paper identifies situations where the bases can implement efficient outcomes, and where they fail. The paper also shows how non-discrimination obligations might improve upon the outcomes.

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Contents

1 Introduction

Firms that participate in standard-setting or standard-developing organizations commit to make their patents available to future implementers of the standards on "fair, reasonable and non-discriminatory" (FRAND) terms, should their patents become essential to the use of the standards. These commitments are intended to limit the ability of holders of such standard-essential patents (SEPs) to exploit the market power that the essentiality of their patents yields. The more precise meaning of the FRAND commitments is typically not specified, however. Conflicts therefore often arise between SEP holders and potential implementers regarding the practical interpretation of the concept. SEP holders frequently seek injunctions against firms that want to implement their protected technologies. and implementers seek legal recourse against SEP holders, based on alleged unwillingness of the counterparts to accept FRAND terms. The enforcement of FRAND commitments is viewed as primarily falling under private contract law in e.g. the laws of many European states, Canada and the US. But violations of FRAND commitments can fall under antitrust in all major economies (as abuse of dominance, or similar), if the right holder has market power. Antitrust laws have recently been applied to SEPs, for instance, in China, the EU, South Korea, Taiwan and the US.

National regulations of FRAND commitments are causing increasing international tensions. These tensions largely arise from the fact that *countries have different interests with regards to the enforcement of FRAND commitments for most SEPs.* For instance, products that draw on SEPs are often produced in certain countries and exported to other countries, and the holders and implementers of SEPs often reside in different countries. Countries therefore have different interests with regard to the interpretation and enforcement of FRAND commitments, depending on their roles in the production chains.

Diverging national interests would not necessarily matter if there were a multilateral agreement on the implementation of FRAND commitments. However, no such agreement exists. Countries instead decide unilaterally how to enforce these undertakings. It is increasingly alleged that national authorities pursue national commercial objectives when deciding on their interventions. For instance, China, Taiwan and South Korea have been criticized for using antitrust interventions against alleged violations of FRAND commitments as a form of industrial policy. In the words of Patrick Ventrell, US White House National Security Council spokesman:

> The United States government is concerned that China is using ... anti-monopoly law, to lower the value of foreign-owned patents and benefit Chinese firms employing foreign technology.[1]

Similar concerns have been addressed by legal scholars and practitioners.[2]

[1] Reuters, Dec 16, 2014. www.reuters.com/article/us-qualcomm-china-antitrust-idUSKBN0JU0AK20141216.

[2] For example, based on patent application data from the EU, Japan and the US, Webster, Jensen and Palangkaraya

When countries diverge in their views on how to enforce FRAND commitments, they will typically have *conflicting interests with regard to the choice of regulating authority*. Just like their is no multilateral agreement on how to interpret the FRAND notion, there is no such agreement to turn to in order to determine the allocation of jurisdiction. However, all countries are still legally bound by *the default rules for international jurisdiction* in customary international law. These rules have emerged as a result of systematic state practice, and apply absent international agreements. The respect for these principles is of fundamental importance to the world economy (and to international relations generally). Indeed, the principles are so deeply ingrained in international relations that it is easy to forget that they exist. For instance, we take for granted stronger countries do not tax firms and workers in weaker countries. That it is not done can probably be ascribed to a respect for the importance of maintaining the integrity of basic jurisdictional principles in international law.[3]

This paper The purpose of the paper is to examine the economic performance of the two main bases for jurisdiction in the default rules—*the Territoriality and Nationality Principles*—with regard to the enforcement of FRAND commitments. Do these rules allocate jurisdiction across national authorities in an economically efficient manner, and if not, what pros and cons do they have? These issues are of direct policy concern. If the default rules can be shown to implement efficient outcomes, existing law is adequate from an economic perspective. The problem, if any, then is to ensure that countries comply with the law. On the other hand, if the rules cannot implement an efficient outcome, there is a need to look for alternative solutions, in the form of other jurisdictional principles, or more likely in the form of an international agreement.

Related literature To the best of our knowledge, this is the first paper to address the economic efficiency of the fundamental default rules in international law for any application. But there are obviously several related fields of literature. For instance, there is a very large economic literature on competition policy in international markets. A basic theme in this literature is that competition authorities' in open economies tend to promote not only consumer welfare in the traditional sense, but also other objectives; see e.g. the discussion by Mariniello, Neven and Padilla (2015).[4] Indeed,

(2014) establish a higher propensity to accept applications from domestic than foreign applicants; Wong-Ervin, Wright, Kobayashi and Ginsburg (2016) argue that some competition authorities appear to enforce FRAND commitments so as to benefit their local implementers or national champions; de Rassenfosse, Jensen, Julius and Webster (2019) identify a bias against foreign firms using patent data from five major economies that jointly account for approximately 80% of global patenting; and de Rassenfosse and Raiteri (2022) find strong evidence for such protectionism by the Chinese patent office with regard to what they define as strategic patents (albeit not for other patents).

[3] The importance of these rules is vividly illustrated by the very strong resistance against unilaterally imposed carbon tariffs on imports. The EU introduced such a measure in 2008 when the EU Emissions Trading System was extended to apply to aviation. This created such adverse international reactions from governments representing some 3/4 of the global population that the EU very soon completely withdrew the measure. At the core of this resistance was the perception that the measure violated jurisdictional principles, by imposing extra-territorial taxation.

[4] A recent example is the proposed EU taxation of digital firms, which has been alleged to be motivated by the fact that it would primarily hit US firms. The notion that competition law is used to promote national objectives is not uncontested, however. For instance, Auer and Manne (2019) argue that it is in practice almost impossible

national authorities might be legally required to treat foreign interests different from national interests; that the US Sherman Act does not apply to export cartels without effect in the US market is an example of this. Authorities might also be under domestic political pressure to favor domestic firms, or may be lobbied to do so by private parties.

A considerable law and economics literature on SEPs. A main issue in this literature is how to define or determine the "reasonable" part of the FRAND concept, and the circumstances under which SEP holders should be allowed injunctions against implementers for not agreeing to the requested terms for using the patented technologies.[5] There is also a significant literature that discusses the appropriate role of antitrust for the enforcement of FRAND commitments.[6]

Yet another related literature examines the role of SEPs for innovation in closed economy settings. For instance, Spulber (2019) develops a fully dynamic model of SEPs to this end, with endogenously determined research and development, inventor-producer bilateral bargaining, and subsequent Bertrand product market competition. The present paper uses a much simpler economic setting in the belief that the issues that will be shown to arise here will also appear in richer settings.

Finally, the literature does occasionally address problems stemming from multiple jurisdictions for FRAND enforcement. For instance, Wong-Ervin, Wright, Kobayashi and Ginsburg (2016) emphasize the transaction costs that arise from differences in legal regimes, and Erixon and Bauer (2017) discuss the possibilities for SEP holders to select courts that are prone to grant injunctions (forum shopping). But these papers do not examine jurisdictional issues that arise in international markets. More directly related to this paper is Contreras' (2021) discussion of jurisdictional conflicts that have arisen from anti-suit and anti-anti-suit injunctions in 16 FRAND cases during 2012-2021. But the paper does not formally analyze the nature of these conflicts, or the implications of relying on different jurisdictional principles for the assignment of jurisdiction.

The framework to be employed The paper uses a highly stylized economic framework to capture basic conflicts of interest over the allocation of jurisdiction over FRAND enforcement. In this framework, a product is produced in one country and exported to another country. The product builds on a standard that draws on two patents. The patents are essential in two respects: both patented technologies are required in order to manufacture and sell the product, and the two

to determine whether the EU's drive to tax digital firms is a reflection of protectionism, or a non-discriminatory application of competition law. And Bradford, Jackson Jr. and Zytnick (2017) find no evidence to suggest that the Commission has challenged non-EU mergers decisions to a larger extent than intra-EU mergers during 1990-2014.

[5] See e.g. Contreras (2019) for a survey of the literature on standard-setting organizations. Formal analyses of the FRAND notion are undertaken by e.g. Froeb, Ganglmeir and Werden (2012), Langus, Lipatov and Neven (2013), Choi (2014), and Lerner and Tirole (2015). Layne-Farrar (2017) surveys the economic literature on SEPs.

[6] See e.g. Hovenkamp (2020) for a recent legal analysis of the role for antitrust for the enforcement of FRAND commitments. Padilla, Ginsburg and Wong-Erwin (2018) provide a comprehensive overview of antitrust enforcement regarding intellectual property and standards in the EU, the US, Japan, China, India and South Korea. Geradin (2020) discusses the EU stand on SEP licensing and its relationship with EU competition law. Nikolic (2022) summarizes EU use of antitrust for FRAND enforcement.

holders of the patents are bound by FRAND commitments to charge "reasonable" license fees. In each country a regulatory authority can intervene to enforce its view of the meaning of the FRAND commitments, by imposing a ceiling on the permissible license fee(s) for which it has jurisdiction.

The interaction takes place in three stages. The regulatory authorities first simultaneously lay down FRAND policies for the patent(s) for which they have jurisdiction. There are then simultaneous separate negotiations between the producer and each of the two SEP owners regarding per unit royalty fees. These negotiations are interrelated, since the surplus that can be divided between each of the SEP holders and the producer, will be adversely affected by the license fee that they expect to be agreed upon between the producer and the other SEP holder. To formally capture this, the outcome is assumed to be a "Nash-in-Nash" equilibrium, as in Horn and Wolinsky (1988). In the final stage there is production and consumption in standard fashion.

Each authority interprets a license fee to be "reasonable" if it does not exceed the authority's preferred level. In line with the ambit of actual antitrust policy, the authorities cannot implement higher fees than what the SEP holders and the firm negotiate, even if they should so prefer. The authority in the importing country is concerned with the implications of the negotiated fees for domestic consumer welfare and for the welfare of its SEP holder(s) if any, while the authority in the exporting country is concerned with the implications of the fees for its exporting firm, and for its SEP holder(s), if any. The assumption that the authorities value license revenue for domestic SEP holders is intended to serve as a short-hand for their desire to provide local incentives for innovation. This is obviously a strong assumption, but it seems to capture the essence of the FRAND problem—that there are positive social implications of allowing for strictly positive license revenues for domestically held patents—without having to bring in the complexities of a full-fledged dynamic analysis of innovation.

Simple as this economic structure is, it captures the fundamental difference in the interests of countries with regard to the enforcement of FRAND commitments. Some countries are mainly concerned with the implications for consumer welfare and for the incentives for innovation, while for other countries the main interest lies in production that draws on the SEPs. But there is also a wide range of legal issues regarding FRAND commitments that the paper disregards or assumes away.[7]

Findings In our framework, both authorities will want to minimize the license fee for the respective foreign-owned SEP(s). For the patent-issuing country, this will enhance consumer welfare by reducing the equilibrium product price. For the exporting country, minimizing the license fee for SEP(s) held by the patent-issuing country will enhance the profit of its producer. Also, since the bargaining processes for the SEP licenses are interrelated, both countries prefer a minimal license fee for the respective foreign SEP, to increase the surplus that is available for its domestic SEP

[7] Just to mention a few examples, it does not capture conditions for the use of injunctions, and the treatment of patent portfolios involving patents in different countries.

holder(s), if any, to divide with the producer. The outcome thus yields inefficiently stringent regulation of the FRAND commitments absent observance of jurisdictional principles, compared what would result with a single authority in an integrated economy.

The paper then considers the impact of allocating jurisdiction over the enforcement of FRAND commitments based on the Territoriality Principle and/or the Nationality Principle. The paper establishes the following:

- If jurisdiction is allocated according to the Territoriality Principle, the outcome converges toward the efficient outcome, as the patent-issuing country becomes concerned with consumer welfare only. The Nationality Principles performs worse in this case, and might yield lower joint welfare for the countries than when no jurisdictional rule is applied.

- The outcome with the Nationality Principle converges toward the efficient outcome as the concern for license revenues for SEP holders increasingly dominates the decision making by both regulatory authorities. The Territoriality Principle then performs worse.

- For intermediate cases neither jurisdictional base achieves full efficiency. The Territoriality Principle gives too weak enforcement of FRAND commitments for patents that are owned by nationals of the country that has issued the patents, and too stringent enforcement when they are owned by foreign interests. The Nationality Principle gives too lenient enforcement for all patterns of ownership of the patents.

- When both principles are applied simultaneously, as jurisdictional rules would allow, the Nationality Principle is superfluous.

Put differently, the analysis suggests that *the Territoriality Principle performs best when the regulatory authorities have a common interest in maintaining low license fees for both SEPs, and Nationality Principle when each authority prefers a high license fee for its domestically held SEP.*

These findings reflect a general weakness of these basic jurisdictional principles: adherence to the default rules *does not remedy the international externalities* that stem from countries' pursuit of nationally defined objectives. While the default rules solves the problem of allocating jurisdiction, only in extreme cases will the country or countries that have been awarded jurisdiction unilaterally behave in a jointly efficient fashion.

The jointly efficient regulation of the FRAND commitments requires that the two SEPs are treated equally. The inefficiency of the default rules therefore at least partly seems to stem from the fact that they allow countries to *discriminate* in their enforcement of FRAND commitments, The Territoriality Principles implies explicitly discriminatory regulation, since the regulating country prefers to treat SEP holders differently based on nationality. Discrimination is more subtle with the Nationality Principle, but the outcome can imply different regulatory treatment depending on SEP holders' territorial location.

This raises the question of whether a prohibition of discriminatory regulation could improve the efficiency of the outcome. This question is not only of conceptual interest. All major economies are as members if the World Trade Organization (WTO) legally bound to respect the *Agreement on Trade-Related Aspects of Intellectual Property Rights* (the TRIPS Agreement). It includes provisions that can make discriminatory treatment of FRAND commitments illegal. In February 2022, the EU brought the first WTO dispute concerning enforcement of FRAND commitments before the WTO Dispute Settlement mechanism, which signals that the TRIPS Agreement can potentially be applicable to FRAND enforcement. It also seems highly plausible that a National Treatment obligation would be a central component of any future international agreement on the enforcement of FRAND commitments.

The paper therefore considers several aspects of how a non-discrimination clause might interact with the defaults rules. It is shown that:

- The Territoriality Principle coupled with a National Treatment obligation can implement a jointly efficient outcome. This is more likely to be the outcome, the more the interests of the two regulatory authorities are aligned. But the imposition of the National Treatment obligation might also reduce joint welfare.

- Regulation based on the Nationality Principle will not be constrained by a National Treatment provision. However, a more general form of non-discrimination obligation, similar to the "consistency requirement" in WTO law, can have favorable impact. Broadly speaking, it would request that countries adopt the same regulatory stance with regard to FRAND enforcement in different industries, regardless of differences in countries' commercial interests across industries.

- A National Treatment obligation can have beneficial effects also when allowing both countries to regulate based on an extreme version of a third jurisdictional base in the default rules, the *Effects Principle*.

The broader conclusion that emerges from the analysis is that *existing principles for jurisdiction in international law typically will typically not implement an efficient outcome when applied to SEPs in international markets,* and that a non-discrimination obligations can, but need not, improve the outcomes. These findings suggest the need for some form of international agreement. But the analysis also suggests that it will not be easy to identify an implementable agreement with desirable properties.

The structure of the paper The next section gives a brief description of the default rules for international jurisdiction. Section 3 lays out the simple economic market structure, including the negotiations over the license fees. Section 4 derives and compares the outcomes with the two main

traditional bases for jurisdiction in the defaults rules: the Territoriality and Nationality Principles. Section 6 extends the analysis to include non-discrimination obligations. Section 7 concludes.

2 The default rules for jurisdiction

All countries are bound by the default rules for the allocation of jurisdiction in customary international law.[8,9] These rules have emerged as custom from many years of interaction between states in a large number of different areas. Being part of customary international law, these rules are not laid down in multilateral treaties. But a widely accepted interpretation of these rules is provided in the series of *Restatements of Foreign Relations Law of the United States* by the American Law Institute (ALI).[10] In what follows, we will draw on the ALI (1987) and ALI (2018) Restatements to describe main features of current jurisdictional rules in customary international law.[11]

There are three forms of jurisdiction. Jurisdiction to *prescribe* gives a state authority to make laws that apply to *actors, acts* or *objects.* Jurisdiction to *adjudicate* allows a state to litigate disputes in its domestic courts. Jurisdiction to *enforce* allows a state to intervene to induce compliance with laws. These are clearly separate aspects of jurisdiction. But we will not distinguish between them in what follows. We will instead assume that if a regulatory authority has jurisdiction to prescribe, it also has jurisdiction to adjudicate and enforce, this being the prime case of interest from an economic perspective.

In order for a state to have jurisdiction to prescribe there must be a "genuine connection" between the subject of the regulation and the state seeking to regulate. Such a connection might stem from one or several bases.[12] The oldest, most frequently used, and least controversial base is the location of actors, acts and objects within a state's geographic territory—the *Territoriality Principle.* Another jurisdictional base with a long tradition is the nationality of these entities—the *Active-Nationality Principle.* A more controversial, but increasingly commonly used, base is the substantial effects that arise (or are intended to arise) within a state's territory—the *Effects*

[8] Customary international law is formed when states act in a consistent fashion out of a sense of obligation. It applies to international relations in instances where there is no international treaty governing the relationship. The exception is if a country has persistently objected to a custom. But this does not appear to be of practical relevance to SEPs.

[9] The basic rules concerning jurisdiction were spelled out in the classic "Lotus judgment" in 1927 by the Permanent Court of International Justice (the predecessor of the International Court of Justice).

[10] ALI Restatements are meant to clarify the state of the law for the benefit of US courts, and are often used by courts as authoritative interpretations of the law. The latter stems from the thorough process through which the ALI memberership, comprising some 3 000 leading US legal scholars and professionals, scrutinize the development of the Restatements. It should noted however that the Restatements reflect mainly US perceptions of customary international law, and not necessarily the understanding of the International Court of Justice.

[11] See also Lundstedt (2016) for a comprehensive description and analysis of jurisdictional principles, in particular as they apply to intellectual property law.

[12] ALI (2018) points to two additional bases: the protective principle, which is concerned with national security, and universal jurisdiction, which concerns interventions in the case of crimes against humanity etc. These are omitted here since they seem irrelevant to the issues at stake in the paper.

Principle (or Effects Doctrine). This basis, which is often seen as a special case of the Territoriality Principle, is commonly referred to in the area of antitrust.[13]

The default rules can simultaneously give jurisdiction to more than one party. For instance, in the case of SEPs, the territorial applicability of a patent, and the nationality of the holder of the patent, might point in different directions with regard to which party should have jurisdiction. In the past there was a clear hierarchy in international law according to which the Territoriality Principle dominated both the Nationality and the Effects Principle; see the ALI (1987) Restatement. But the recent ALI (2018) Restatement unequivocally states that there is no hierarchy among the bases in international law, even if some bases are more controversial than others. We need not take a stand on this issue, however.

A possible solution in case of conflicting jurisdiction is *comity*, that is, that despite having jurisdiction, countries defer to other countries to exercise jurisdiction, if the latter have larger legitimate interests at stake.[14] There is no requirement in customary international law for states to do so. But countries nevertheless occasionally do this unilaterally through domestic laws and regulations that constrain the exercise of prescriptive jurisdiction. There are also some international comity agreements, the most well-known is probably the 1998 EU-US positive comity agreement, under which each side may request the other side to remedy anti-competitive behavior which originates in the other side's jurisdiction but affects the requesting party. However, comity in practice seldom provides a solution to jurisdictional conflicts, as it is predicated on subjective assessments of what matters and how much in two distinct jurisdictions.

In what follows we will focus on the principles regarding territoriality and active nationality ("nationality" for short below) since these seem most relevant to SEPs. We will also touch upon implications of the Effects Principle, but we will be briefer for reasons explained below.

3 The economy

A product is exported from country B to country A by a monopoly firm. The product is based on a standard that draws on two essential patents, denoted 1 and 2, with separate holders.[15] The firm negotiates separately and simultaneously with each SEP holder the respective license fees r_1 and r_2 per unit sold of the final product in market A.

The patents are essential in two respects. First, the product cannot be produced without the use of both patents, and second, the standard has been developed with (FRAND) commitments by the patent holders to charge "reasonable" license fees. In each country there is a regulatory authority

[13] Yet another controversial but increasingly common justification for regulating conduct outside a state's territory is to protect domestic nationals against harm—the *Passive-Nationality Principle*.

[14] See Drahozal (2012), and Wong-Ervin and Heimert (2021), for analyses of comity.

[15] Some of the issues to be discussed could arise also with one patent. But assuming two (or more) patents allows us to examine additional issues, such as strategic aspects to the design of FRAND enforcement policies, and in particular discrimination between domestic and foreign patents.

that seeks to enforce the FRAND commitments for the SEP(s) for which it has jurisdiction. There are three stages in the interaction for any given allocation of jurisdiction over the SEPs:

1. Each regulatory authority lays down a FRAND enforcement regulation that sets ceilings for license fees for which it has jurisdiction;

2. License fees are negotiated, respecting any FRAND regulations; and

3. Production and consumption take place.

This sequence of events is intended to capture countries' long-run legislative decisions regarding their enforcement of FRAND commitments.

3.1 The product market

Let $D(p) \equiv \arg\max_c \tilde{U}(c) - pc$ be consumer demand in market A, where $\tilde{U}(c)$ is gross consumer welfare, p is the product price, and c is the level of consumption. For given license fees, the single producer maximizes its profit in standard fashion by setting the price

$$P(\mathbf{r}) \equiv \arg\max_p \ (p - \sum r_i)D(p),$$

where $\mathbf{r}$ denotes the vector (r_1, r_2).[16] The firm's optimal price is assumed to increase less than proportionally in each of the fees. Letting subscripts attached to function operators denote partial derivatives, and subscript i represent both SEP 1 and 2, we thus assume that

$$0 < P_i(\mathbf{r}) < 1; \tag{1}$$

a sufficient but not necessary condition for which to hold is that $D_{pp} \leq 0$.

The maximized profit and consumer welfare are

$$\begin{aligned} \Pi(\mathbf{r}) &\equiv [P(\mathbf{r}) - \sum r_i]D(P(\mathbf{r})), \\ U(\mathbf{r}) &\equiv \tilde{U}(D(P(\mathbf{r}))) - P(\mathbf{r})D(P(\mathbf{r})), \end{aligned}$$

both of which fall in the magnitudes of the license fees: $\Pi_i = -D < 0$ and $U_i = -DP_i < 0$.

3.2 License fee negotiations absent regulation

The firm negotiates the license terms simultaneously with the two SEP holders. $L^i(\mathbf{r}) \equiv r_i D(P(r_i, r_j))$ denoting the license revenue received by the holder of SEP i. The outcome of the bargaining is assumed to be a "Nash-in-Nash" equilibrium, as in Horn and Wolinsky (1988), with the status

[16] We assume throughout that second-order condictions are fulfilled for any optimization problems we consider. These conditions are verified to hold in a fully parametric example in the Appendix.

quo point $(0,0)$ since each patent is essential. Hence, the negotiation over license fee r_i maximizes $\Pi(r)L^i(\mathbf{r})$, with the fee r_j at its equilibrium value. The associated first-order condition for an interior solution to the negotiation over fee r_i,

$$-Dr_i + (p - \sum r_i)(D + r_i D_p P_i) = 0, \tag{2}$$

defines a function $r_i = N^i(r_j)$ for the case where the outcome of the negotiation is not constrained by enforcement of FRAND commitments:

$$N^i(r_j) \equiv \arg\max_{r_i} \Pi(\mathbf{r})L^i(\mathbf{r}).$$

Three natural assumptions are made regarding the negotiations. The first is that the fee that is negotiated between one of the SEP holders and the firm, is lower the higher is the fee for the other SEP:

$$N^i_j < 0. \tag{3}$$

This is natural since a smaller r_j will give more surplus to be divided between the producer and SEP i holder, and part of this additional surplus will accrue to the holder of SEP i in the form of a higher r_i. Second, we assume that there is a unique equilibrium $r^0_1 = r^0_2 \equiv r^0$, given by

$$r^0_i = N^i(r^0_j),\ i \neq j \tag{4}$$

for the unconstrained negotiations. Finally, in order have intuitively reasonable comparative statics properties, we assume that the interaction between the two bargaining processes is "stable" in the sense that the relative slope of the two functions in (4) is such that at $\mathbf{r}^0 \equiv (r^0, r^0)$,

$$N^j(N^i(r)) > r_j \text{ iff } r_j < r^0. \tag{5}$$

To see why this is assumed, suppose that the negotiated fee r_i, for given r_j, increases due to some exogenous factor. In the "unstable" case, this will trigger a change in r_j that in equilibrium causes a *fall* in r_i despite the direct positive impact of the exogenous change. Assumption (5) serves to remove this formally feasible, but counter-intuitive, possibility.

3.3 The impact of regulatory interventions on negotiated license fees

Interventions by the regulatory authorities are constrained in two respects: First, the authorities will only intervene with regard to SEPs for which they perceive they have *jurisdiction*. Second, the authorities can only intervene to limit the patent holders' exploitation of market power in the form of high fees for the patents, that is, they can only impose *upper limits on permitted license fees*. The authorities cannot implement higher fees than those negotiated between the producer and

the respective patent holder; this is intended to capture the nature of most antitrust interventions. Importantly, *in case both authorities impose restrictions on a particular license fee, the SEP holder is assumed to comply with both regulations by respecting the more stringent of the two.*

Formally, let m_i^A and m_i^B be the maximal fees allowed by the respective regulatory authority for SEP i. The maximal permitted fee for SEP i will then be $m_i \equiv \min(m_i^A, m_i^B)$. Let $\mathbf{m} \equiv (m_1, m_2)$ be the pair of most binding regulations.[17] Four types of situations may arise as a result of the regulatory decisions.

(i) $\mathbf{m} < \mathbf{r}^0$: If both fees are regulated to levels below what would result without regulation—that is, $\mathbf{m} < \mathbf{r}^0$—both interventions will bind: $\mathbf{r} = \mathbf{m}$.

(ii) $\mathbf{m} \geq \mathbf{r}^0$: In the opposite case where neither of the interventions affects the negotiated outcomes—that is, $\mathbf{m} \geq \mathbf{r}^0$—the outcome is the pair of fees resulting from unconstrained negotiations: $\mathbf{r} = \mathbf{r}^0$.

(iii) $m_i < r^0$ and $m_j > N^j(0)$: In this case with asymmetric regulation, one of the constraints is lax enough not to bind regardless of the negotiated fee for the other SEP. The implemented fee for the leniently treated SEP is then determined through an unregulated negotiation, but constrained by the expected outcome of the parallel negotiation. For instance, if $m_2 > N^2(0)$, the feasible outcomes are points $\mathbf{r} = (m_1, N^2(m_1))$ where $r_1 \in [0, r^0]$ is the implementable range of r_1 for RA.

(iv) $m_i < r^0$ and $r^0 < m_j < N^j(0)$: If $r^0 < m_2 < N^2(0)$ there will be a critical value of m_1 for any m_2, denoted $R^1(m_2)$, which is the level of m_1 that would induce the unconstrained negotiation over SEP 2 to result in the fee $r_2 = m_2$. That is, $N^2(R^1(r_2)) \equiv r_2$, and more generally $R^i(r_j)$ is given by

$$N^j(R^i(r_j)) \equiv r_j. \tag{6}$$

If $m_1 \leq R^1(m_2)$, the implemented fee r_1 would be sufficiently low that the regulation $r_2 \leq m_2$ restricts the outcome of the negotiation over r_2. In this case the implemented outcome will be $\mathbf{r} = (m_1, m_2)$. If instead $R^1(m_2) < m_1 < r_1^0$, the outcome of an unconstrained negotiation regarding r_2 would be a lower fee than m_2, in which case the regulation $r_2 \leq m_2$ would not bind. The outcome in this case is $\mathbf{r} = (m_1, N^2(m_1))$.

The possible outcomes can hence be summarized as follows:[18]

[17] If neither authority intervenes with regard to patent i we can set $m_i^A \geq N^i(0)$ and $m_i^B \geq N^i(0)$, since this is formally equivalent to a non-binding regulation.

[18] The Appendix provides an example that establishes that the properties that have been assumed in this section are indeed feasible.

Lemma 1 *The negotiated fees* $\mathbf{r}$ *depend on the regulations* m *as follows:*

$$\mathbf{r}(\mathbf{m}) \equiv \begin{cases} \mathbf{m} & \text{if} \quad \mathbf{m} < \mathbf{r}^0 \\ (m_i, \min(m_j, N^j(m_i)) & \text{if} \quad m_i < r_i^0 \text{ and } m_j > r_j^0 \\ \mathbf{r}^0 & \text{if} \quad \mathbf{m} > \mathbf{r}^0. \end{cases} \tag{7}$$

4 Regulatory preferences

We now turn to the first stage of the interaction, in which the regulatory authorities can lay down their regulations of the FRAND commitments.

4.1 An integrated economy benchmark

Assume temporarily that all agents reside in the same integrated economy, in which a single regulatory authority enforces the FRAND commitments by the SEP holders in order to maximize its objective function, which increases in consumer welfare, license revenues for SEP holders and the profit of the producer:

$$W(\mathbf{r}) \equiv U(\mathbf{r}) + \alpha \sum L^i(\mathbf{r}) + \gamma \Pi(\mathbf{r}).$$

The parameter $\gamma \geq 0$ captures the extent to which producer profits are considered as part of welfare, as a generator of income for share-holders, or as a source of tax revenue. With $\alpha = \gamma = 0$ the regulating authority would only be concerned with consumer welfare. With $\alpha = \gamma = 1$ the welfare function reduces to $W(\mathbf{r}) = \tilde{U}(\mathbf{r})$, that is, to the standard social welfare function with no special social benefit from having positive license fees. We will assume that the authorities put some weight on license revenues ($\alpha > 0$). We use this as a compact way of capturing beneficial effects of license fees on innovation, without having to bring in the complexities of a model of endogenous innovation; the issues to be discussed here are likely to arise also in such more complex settings. The function $W(\mathbf{r})$ thus captures in a very simple manner the main conflicting objectives with regard to the license fees for SEPs: the desire to keep license fees low to enhance consumer welfare, versus the desire to provide strong incentives for innovators.

We will use the license fees $\mathbf{r}^J = (r^J, r^J)$ that maximize joint welfare W, or equivalently the welfare of the integrated economy, as the benchmark for measuring the efficiency of the outcome with national regulatory authorities.[19] The jointly optimal fee for patent i balances the positive effect on the revenue for the holder of SEP i, and the adverse effects of the fees on consumer surplus, on the holder of SEP j, and possibly also on the producer (depending on whether $\gamma \geq 0$):

$$\begin{aligned} W_i(r, r) &= U_i + \alpha(L_i^i + L_i^j) + \gamma \Pi_i \\ &= -DP_i + \alpha[D + r_i D_p P_i + r_j D_p P_i], \end{aligned}$$

[19] This is not the first best outcome due to the monopoly distortion, and the policy instruments available to the authority that maximizes W.

where U_i, αL_i^j and $\gamma \Pi_i$ are all negative, and where αL_i^i is positive for small r_i.Let the pair of license fees that maximize joint welfare be denoted $\mathbf{r}^J \equiv (r^J, r^J)$, with $r_1 = r_2$ due to symmetry. r^J is thus given by

$$\begin{aligned} W_i(\mathbf{r}^J) &= V_i^A(\mathbf{r}^J) + V_i^B(\mathbf{r}^J) \\ &= (\alpha - P_i(\mathbf{r}^J) - \gamma) D(P(\mathbf{r}^J)) + 2\alpha r^J D_p(P(\mathbf{r}^J)) P_i((\mathbf{r}^J)) \\ &= 0. \end{aligned} \tag{8}$$

We will focus on situations where the unconstrained jointly efficient regulation restricts the negotiated outcome, but still (mostly) allows for strictly positive fees for the SEPs, that is, where[20]

$$(0,0) < \mathbf{r}^J < \mathbf{r}^0. \tag{9}$$

This excludes corner solutions where the jointly efficient pair of fees do not yield any revenue for SEP holders ($\mathbf{r}^J = 0$), and or where it is jointly efficient to leave the market unregulated ($\mathbf{r}^J \geq \mathbf{r}^0$). A strictly positive r^J requires that

$$W_i(0,0) = (\alpha - \gamma - P_i)D > 0.$$

That is, the marginal benefit of introducing some license revenue for SEP i (αD) must exceed the marginal cost in terms of reduced consumer welfare ($-DP_i$), and reduced industry profit ($-\gamma D$).

4.2 National authorities

Now divide this integrated economy into two countries such that consumption occurs only in country A and production only in country B. We will mainly consider the case where the ownership of the SEPs is split between the countries, since this seems to capture the most common setting for SEPs affecting international markets (other ownership patterns will be examined below, however). To this end, let the holder of SEP 1 be a country A national, and the holder of SEP 2 a national of country B. There is a regulatory authority in each country, denoted RA in country and RB in country B. Their objectives are to maximize, respectively,

$$V^A(\mathbf{r}) \equiv U(\mathbf{r}) + \alpha L^1(\mathbf{r}) \text{ and } V^B(\mathbf{r}) \equiv \gamma \Pi(\mathbf{r}) + \alpha L^2(\mathbf{r}). \tag{10}$$

Observe that the objectives of the national authorities add up to the objective of the authority in the integrated economy: $V^A(\mathbf{r}) + V^B(\mathbf{r}) = W(\mathbf{r})$. Hence, *any deviation in the outcome with separate countries from the efficient outcome, is solely due to international externalities from the national decision making regarding the FRAND commitments.* Formally, the international dimension drives

[20] Vector notation $\mathbf{r} < \mathbf{r}'$ denotes $r_i < r_i'$, $i = 1, 2$, etc..

a wedge between the interests of the national authorities, since each authority prefers the license revenue of the other country's SEP holder to be as small as possible:

$$V_2^A = -DP_2 + \alpha r_1 D_p P_2 < 0 \text{ and } V_1^B = -\gamma D + \alpha r_2 D_p P_1 < 0.$$

To reduce the number of cases to consider, we assume that the authority in the patent-issuing country A, prefers a higher license fee for its domestically owned SEP, the lower is the license fee for the foreign owned SEP, that is, the license fees are strategic substitutes for RA:

$$V_{12}^A < 0.$$

This condition holds e.g. in the fully linear version of the model in the Appendix.

4.3 The outcome when both countries regulate

If the regulatory authorities were to abstain from regulating the FRAND commitments, the license fees would be $\mathbf{r}^0 > 0$. If the authorities instead see themselves free to regulate as they wish, they would both intervene. Each SEP holder is a national of one of the countries, but not of the other. The interest of both regulatory authorities is to minimize the fee for the respective foreign-owned SEP, either because this increases consumer welfare, or the profits of the producer. Without adherence to rules that restrict jurisdiction, country i would therefore impose a regulation $m_j^{No} = 0$ on license fee r_j. Since this applies to both SEPs, the outcome absent regulation would be $\mathbf{r} = \mathbf{0}$.

Lemma 2 *Absent rules that restrict jurisdiction, the equilibrium features zero license fees for both SEPs.*

Since $\mathbf{r}^J > 0$ there is too stringent regulation absent adherence to jurisdictional principles. Then, to what extent can the main jurisdictional bases in the default rules improve upon the outcome?

5 The performance of the two basic jurisdictional principles

Jurisdiction can be exercised with respect to *acts, actors* and *objects*. Jurisdiction over each of these entities can potentially derive from one or more of the three jurisdictional principles discussed above. It is in practice often a delicate task to determine the implications of these principles for the allocation of jurisdiction. First, the identification of the relevant acts, actors and objects can sometimes be difficult. Second, whether a particular jurisdictional principle is applicable to a particular act, actor or object, is also often unclear. And sometimes the application of a principle points in different directions when applied to acts, actors and objects. The appropriate allocation of jurisdiction under the default rules will therefore often be a source of conflict, and it will typically depend on the specifics of the situation at hand.

But it seems reasonable in the present context to see the relevant acts as the demands by the SEP holders regarding license fees, the actors as the SEP holders, and the objects as the SEPs. The appropriate application of the Territoriality and Nationality Principles to these entities must be considered separately.

5.1 The Territoriality Principle

Consider first implications of applying the Territoriality Principle. The main territorial dimension of acts is normally the geographic location where they take place. But in our setting it seems to be less relevant whether the act of negotiating the SEP license fees, or of deciding on the fees, physically take place in one country or the other, if at all possible to determine. Also, it is hard to see how the identity of the actors could have any territorial significance beyond their nationality (which falls under the Nationality Principle). The objects at issue, the SEPs, have clear territorial features however, since the patents apply to the territory of country A, and only to this territory. It is thus quite clear that an application of the Territoriality Principle gives country A jurisdiction over both SEPs, this being where the patents apply.

The outcome with jurisdiction allocated according to the Territoriality Principle will thus be given by the solution to RA's problem

$$\max_{m_1,m_2} \; V^A(\mathbf{r}(\mathbf{m})),$$

with $\mathbf{r}(m)$ defined in (7). RA's incentives with respect to the license fee for the foreign-owned SEP 2 are clear: it will prefer r_2 to be as low as possible, since this will minimize the consumer price, and maximize the revenue available for SEP holder 1 to share with the foreign producer:

$$\begin{aligned} V_2^A &= U_2 + \alpha L_2^1 \\ &= -DP_2 + \alpha r_1 D_p P_2 < 0, \end{aligned} \tag{11}$$

Since RA can implement $r_2 = 0$ without reducing its choice set with regard to r_1, it will do so by setting $m_2 = 0$.

RA has conflicting interests with regard to the license fee for SEP 1:

$$V_1^A = -DP_1 + \alpha[D + r_1 D_p P_1] \gtrless 0. \tag{12}$$

Hence, an increase in r_1 drives up the product price and thereby reduces consumer welfare, $U_i < 0$. The resulting lower demand tends to reduce the license revenue. But a higher r_1 has the direct effect of increasing the revenue for SEP 1. But RA's most preferred fee for SEP 1 is strictly positive, since

$$V_1^A(0,0) > V_1^A(r^J,0) > V_1^A(r^J,r^J) = -V_1^B(r^J,r^J) > 0.$$

where the first inequality follows from $r^J > 0$ and $V_{11} < 0$, the second inequality from $r^J > 0$ and $V_{12}^A < 0$, and the equality from the definition of r^J. The first-order condition for an interior m_1 is hence

$$V_1^A(m_1, 0) = -DP_1 + \alpha[D + m_1 D_p P_1] = 0. \tag{13}$$

One possible outcome is that RA prefers to restrict the maximum FRAND-compatible license fee to $m_1' < r^0$, with $m_1' = r_1' > 0$ given by

$$V_1^A(r_1', 0) = 0. \tag{14}$$

This requires that $\alpha > P_1$. This most preferred outcome for RA will be implemented if $r_1' \leq N^1(0)$, since RA can then restrict the license fee to its most preferred level by setting $m_1' = r_1'$. The other possibility is that RA would prefer a license fee $r_1' > N^1(0)$. The implemented outcome will then be $N^1(0)$ since this is what will be negotiated given the constraint $m_2 = 0$. There is consequently in this case no point for RA to intervene regarding the FRAND commitment for SEP 1. Whether RA will prefer one or the other will depend on the relative weight it puts on license revenues relative to consumer welfare. Let α' be such that

$$V_1^A(N^1(0), 0; \alpha') \equiv 0. \tag{15}$$

It follows from (12) and (2) that V_1^A increases in α. Hence, for $\alpha > a'$, RA prefers a license fee that exceeds $N^1(0)$.

Lemma 3 *When SEP holder 1 is a country A national, SEP holder 2 is a country B national, and RA is awarded jurisdiction over both SEPs based on the Territoriality Principle, the resulting regulation of the FRAND commitments will be:*
(i) $\mathbf{r} = (r_1', 0)$ *with* r_1' *given by (14) for* $\alpha < \alpha'$*, and*
(ii) $\mathbf{r} = (N^1(0), 0)$ *for* $\alpha \geq \alpha'$,
where α' *is given by (15).*

When deciding on its regulations, RA disregards the interests of country B. Since $r^J > 0$, RA will be too restrictive vis-à-vis the holder of SEP 2 from the point of view of the integrated economy. But RA will be too lenient regarding the FRAND commitment by the holder of SEP 1. This is clearly the case if $m_1 = N^1(0)$, since $N^1(0) > r^J$. The same holds when $m_1 = r_1'$ as given by (14):

$$\begin{aligned} W_1(r_1', r^J) &= V_1^A(r_1', r^J) + V_1^B(r_1', r^J) \\ &< V_1^A(r_1', 0) + V_1^B(r_1', r^J) \\ &= V_1^B(r_1', r^J) < 0, \end{aligned}$$

again using $V_{12}^A < 0$. Hence, $r_1' > r^J$ by $W_1(r_1', r^J) < 0$.

Proposition 1 *The Territoriality Principle implies that the patent-issuing country will be too lenient in its enforcement of the FRAND commitment for its domestically owned SEP, and too strict in the enforcement of the commitment of the foreign-owned SEP.*

5.2 The Nationality Principle

Consider next the implications of the Nationality Principle. Acts do not seem to have nationality in any meaningful way, at least not in this context, and will thus not serve as a basis for allocating jurisdiction. But actors obviously have nationality. The Nationality Principle would thus allocate jurisdiction for each of the SEPs to the home country of the respective holder. The objects in question, the patents, could possibly be argued to have nationality in that they are issued by country A. But it seems highly plausible that the nationality of the actors should dominate from point of view of the Nationality Principle. We will hence interpret this principle as giving regulatory authorities jurisdiction over their respective national SEP holders.

When each authority regulates only the FRAND commitment of its domestic SEP, the equilibrium regulation will be (m_1', m_2') given by

$$\begin{aligned} m_1' &= \arg\max_{m_1} V^A(m_1, m_2') \leq N^1(m_2') \\ m_2' &= \arg\max_{m_2} V^B(m_1', m_2) \leq N^2(m_1'). \end{aligned}$$

The Nationality Principle hence creates a setting that differs in a fundamental way from the one derived from the Territoriality Principle, in that the implemented license fees will depend on decisions by *both* authorities. That is, the nationally pursued regulations will in certain situations *interact* to determine the outcome.

Several types of Nash equilibria are possible:[21]

(1) Neither fee is regulated When neither fee is subject to binding regulation, the outcome is $\mathbf{r} = \mathbf{r}^0$. Setting $\mathbf{m} \geq \mathbf{r}^0$ will be individually rational for the authorities if

$$V_1^A(\mathbf{r}^0) \geq 0 \text{ and } V_2^B(\mathbf{r}^0) \geq 0.$$

Such a situation can arise if α is large enough that both regulatory authorities prefer such high licenses fees for their nationally held SEPs that they cannot be implemented through the negotiations between the producer and the SEP holders. This type of equilibrium is compatible with the

[21] One potential symmetric Nash equilibrium would be that both authorities set their respective fee to its minimum level, $m_1^A = m_2^B = 0$, so $\mathbf{r} = (0, 0)$. This requires that α is sufficiently small that $V_1^A(0, 0) < 0$ and $V_2^B(0, 0) < 0$. But this outcome is not compatible with the assumption that the jointly optimal outcome is strictly positive, $\mathbf{r}^J > 0$.

assumption $0 < \mathbf{r}^J < \mathbf{r}^0$ since

$$\begin{aligned} W_1(\mathbf{r}^0) &= V_1^A(\mathbf{r}^0) + V_1^B(\mathbf{r}^0) < V_1^A(\mathbf{r}^0) \\ W_2(\mathbf{r}^0) &= V_2^A(\mathbf{r}^0) + V_2^B(\mathbf{r}^0) < V_2^B(\mathbf{r}^0). \end{aligned}$$

So the national authorities will allow for higher license fees than the regulated fees in the integrated economy.

(2) Both fees are regulated Both fees will be regulated if the authorities choose $\mathbf{m}'$ with the property that $m_i' < N^i(m_j')$. In this case the fees will be given by

$$\begin{aligned} V_1^A(\mathbf{r}(\mathbf{m}')) &= U_1 + \alpha L_1^1 = 0 \\ V_2^B(\mathbf{r}(\mathbf{m}')) &= \gamma \Pi_2 + \alpha L_2^2 = 0. \end{aligned} \tag{16}$$

This outcome requires that α is large enough to make both authorities prefer strictly positive fees, but low enough that the implementation constraints are not violated.

In this case, both equilibrium fees would again be higher than in the integrated economy:

$$\begin{aligned} W_1(\mathbf{r}(\mathbf{m}')) &= V_1^B < 0 \\ W_2(\mathbf{r}(\mathbf{m}')) &= V_2^A < 0. \end{aligned}$$

Note that this type of equilibrium can have the feature that even though both FRAND regulations are binding, one of regulations is more lenient than the level that the license fee would have absent regulation: $m_i < r^0 < m_j$. The reason is that when $m_i < r^0$, there will be more surplus for the parties to divide in the negotiation over SEP j. This implies that the unconstrained negotiation over r_j would yield $N^j(m_i) > r^0$. Hence, if $r^0 < m_j < N^j(m_i)$, the outcome in this negotiation is restricted to m_j, implying both restrictions are binding.

(3) One fee is regulated but not the other The third possibility is that license fee i is regulated, but not fee j. The resulting fees will then be $r_i < r^0 < r_j$, with the fees being on the boundary of the set of implementable license fees: $r_j = N^j(r_i)$. For this to occur there must be sufficient asymmetry between the objectives of the two authorities. For instance, this can arise if RA mostly cares about consumer welfare, while RB is mainly concerned with the revenue of its license holder. This can be the outcome if α is small, and γ sufficiently smaller than α; the role of the countries will be reversed if γ is large. Assume e.g. that RB sets $m_2 \geq N^2(0)$. The optimal regulation for RA would then be the m_1' that solves

$$m_1' = \arg \max_{m_1 \leq r^0} V^A(m_1, N^2(m_1)).$$

The interior solution m_1' to RA's problem is given by the solution to the first-order condition

$$V_1^A(m_1, N^2(m_1)) + V_2^A(m_1, N^2(m_1))N_1^2(m_1) = 0. \tag{17}$$

Note that this equilibrium has a novel feature in that RA's problem now has a flavor of Stackelberg leader problem, although the decisions regarding the level of FRAND regulations are still made simultaneously: RA now effectively determines *both* license fees: $r_1 = m_1$ and $r_2 = N^2(m_1)$. The higher is m_1, the higher is the negotiated r_1 (up to $N^1(m_2)$), and the lower will be the negotiated r_2. This stems from the combination of the fact that RB here effectively leaves regulation to RA, and the interrelationship of the two bargaining problems regarding the license fees. RA will hence balance the implication of its choice of m_1 for r_1 against the effect on r_2. The latter effect will tend to lead to a less restrictive regulation of the license fee for SEP 1.

We assumed so far that $m_2 \geq N^2(0)$. But m_2 will in equilibrium be set by RB. For $(m_1', N^2(m_1'))$ to be a Nash equilibrium, it must be optimal for RB not to set $m_2 < N^2(m_1')$, that is, it is required that[22]

$$V_2^B(m_1', N^2(m_1')) \geq 0. \tag{18}$$

Observation 1 *When each authority regulates the FRAND commitment for its domestically held SEP only, the authority with a preference for a lower fee can use a lenient enforcement of its domestic FRAND commitment as a strategic device to reduce the negotiated fee for the foreign-owned SEP.*

Turning to the efficiency of the FRAND regulations in this case, it is clear that $m_2' > r^0 > r^J = m^J$. The enforcement regarding SEP 1 will also be too lenient, given m_2':

$$\begin{aligned} W_1(m_1', m_2') &= V_1^A + V_1^B \\ &= -V_2^A N_1^2 + V_1^B < 0 \end{aligned}$$

by (17), $V_1^B < 0$, and $N_1^2 < 0$.

The findings regarding the FRAND regulations can thus be summarized as follows:

Lemma 4 *When the Nationality Principle awards RA jurisdiction over the country A holder of SEP 1, and RB jurisdiction over the country B holder of SEP 2, the resulting regulation of the FRAND commitments will be one of the following:*
(i) No binding regulation;

[22] We here assume that RB sets $m_2 \geq N^2(0)$, but what is required for the Nash equilibrium is the less stringent $m_2 \geq N^2(m_1')$. However, if RB prefers $m_2 < N^2(m_1')$, the above type of equilibrium will not arise. It will then instead be given by $(R^1(m_2), m_2)$ with $m_2 > r^0$ given by

$$V_2^B(R^1(m_2), m_2) = 0,$$

implying that both negotiated license fees are regulated.

(ii) $\mathbf{m}'$ *as defined by (16); or*
(iii) $(m_1, N^2(m_1))$*.where* m_1 *is the solution to (17).*

We can thus summarize our findings regarding the efficiency of the Nationality Principle as follows:

Proposition 2 *With the Nationality Principle each regulatory authority will enforce the FRAND commitment of its domestic SEP holder too leniently, resulting in too lenient enforcement of both FRAND commitments.*

Note that the strategic incentive that is highlighted in Observation 1 can be sufficiently strong that the regulating authority might find it optimal to allow such a high fee for its domestically held SEP, that it cannot be implemented through the bargaining between the producer and the license holder. In this case there is no interior solution to (17), in which case the Nationality Principle would yield the same outcome as if neither party enforced FRAND commitments.

5.3 The relative performance of the two jurisdictional bases

We have argued that in the present setting, the Territoriality Principle gives exclusive jurisdiction over the SEPs to the country where the patents are issued (country A). This will result in too lenient regulation of this country's domestically owned SEP, and too strict regulation of the foreign-owned SEP. The Nationality Principle, by instead allocating jurisdiction based on the SEP holders nationality, results in too lenient regulation of both SEPs. There is hence a clear pattern for the inefficiencies arising with these jurisdictional principles: *regardless of whether jurisdiction is allocated according to the Territoriality or Nationality Principle, regulating countries will seek to impose too lenient enforcement of domestically owned SEPs, and too stringent regulation of foreign-owned SEPs.* Consequently, neither jurisdictional base will persistently implement the efficient outcome for the integrated economy. However, each jurisdictional base can under certain circumstances implement an efficient outcome, despite the unilateral decision making.

First, the Territoriality Principle gives country A jurisdiction over both SEPs and as a result leads to the maximization of V^A only. It follows from (8) and (13) that $m_1^{TP} > r^J$. But assume that $\gamma = 0$, so that RB's only concern is the with license revenue for the holder of SEP 2. m_1^{TP} and r^J will then both converge to 0 as α converges to $P_i(0,0)$. That is, the outcome with the Territoriality Principle and the jointly efficient solution converge as α becomes small.[23] In this case, the Nationality Principle will still implement a large r_2^{NP} since RB is only concerned with the license revenue. The Nationality Principle hence performs worse than the Territoriality Principle.

Second, if the regulatory authorities are instead effectively concerned only with the license revenues of their respective SEP holders (i.e., α is large), the interests of the authorities would be in

[23] If $0 < \gamma < \alpha$, $r^J = 0$ for $m_1^{TP} > 0$. But as α converges to $P_i(0,0)$, m_1^{TP} converge to 0.

direct conflict, since a higher license fee for one SEP reduces the other negotiated fee. Allocating jurisdiction to RA only, as prescribed by the Territoriality Principle, will then severely harm authority RB, since RA will set $m_2 = 0$. In this case the Nationality Principle performs better, since each authority can ensure a positive license fee for its domestically held SEP. Both regulatory authorities disregard the adverse external effects of a high license fee for their respective domestically held SEP, the fees will be too high: $r_i^{NP} > r^J$. But as α increases, the regulations will eventually become ineffective, $r_i^{NP} = r^0$. As α increases further, $\mathbf{r}^J$ will converge toward $\mathbf{r}^{NP} = \mathbf{r}^0$.

In sum:

Proposition 3 *With split ownership of the SEPs:*
(i) With the Territoriality Principle, the license fees converge to the efficient outcome as α approaches $P_i(0,0)$, while the Nationality Principles yields lower welfare than if both countries disregard jurisdictional rules.
(ii) With the Nationality Principle, the license fees converges to the efficient outcome as α gets large, and it dominates the Territoriality Principle.

The weakness of the Territoriality Principle from an efficiency point of view is that it leads to the maximization of V^A only. On the other hand, since the same regulatory authority will regulate both fees, this principle avoids problems from the interaction between the fees. As α converges to $P_i(0,0)$ the two authorities' interests tend to become aligned, since the prime objective for RA—consumer surplus—and the prime objective for RB—producer profit—both benefit from low fees. Hence, letting RA regulate both fees, as prescribed by the Territoriality Principle, will not be very harmful to RB. The Nationality Principle instead allows both objective functions to be maximized, but it has the disadvantage of causing each of the maximizations be done with respect to one of the fees only. Hence, neither principle can implement full efficiency in general, but each of them can implement a jointly efficient outcome.

Observation 2 *The Territoriality Principle performs best when the regulatory authorities have a common interest in maintaining low license fees for both SEPs, and Nationality Principle when each authority prefers a high license fee for its domestically held SEP.*

5.4 Other international patterns of ownership of the SEPs

The framework above assumed that there is one SEP holder in each country. But the gist of the statements in Propositions 1 and 2 continue to hold for settings where both SEP holders reside in the same country as well.

To see why, consider first the Territoriality Principle. When both SEP holders are nationals of country B, the objective of the country A regulatory authority is simply to maximize consumer surplus: $V^A(\mathbf{r}) \equiv U(\mathbf{r})$. This is achieved by restricting the license fees as much as possible. Hence,

the optimal regulation for RA is in this case $m_1 = m_2 = 0$. Since the jointly optimal levels are strictly positive, this regulation is too strict.

When instead both SEP holders are country A nationals, RA will take their revenues as well into account:

$$V^A(\mathbf{r}) \equiv U(\mathbf{r}) + \alpha \sum L^i(\mathbf{r}). \tag{19}$$

RA will prefer $\hat{\mathbf{r}} = (\hat{r}, \hat{r})$ given by $V_i^A(\hat{\mathbf{r}}) = 0$. RA will thus choose the regulation $\mathbf{m} = \hat{\mathbf{r}}$, provided that $\hat{\mathbf{r}} \leq \mathbf{r}^0$ so that $\hat{\mathbf{r}}$ can be implemented. Since RA will now allow for a strictly positive fee for SEP 2, it follows from $V_{12}^A < 0$ that $m_1 = m_2$ will be more stringent than what RA imposes on SEP 1, in the case where the SEP holder 2 is a national of country B. It follows from the assumption that the jointly efficient fee $\mathbf{r}^J$ is interior ($0 < \mathbf{r}^J < \mathbf{r}^0$), and thus here given by

$$V_i^A(\mathbf{r}^J) + \gamma \Pi_i(\mathbf{r}^J) = 0,$$

that $V_i^A(\mathbf{r}^J) > 0$. That is, the optimal regulation for RA is $\mathbf{r}^J < \mathbf{m} = \hat{\mathbf{r}} \leq \mathbf{r}^0$.

Consequently, Proposition 1 holds for these more extreme settings as well, when slightly reworded to reflect the number of SEP holders for the patent-issuing country.

Now turn to the Nationality Principle. When both SEP holders are nationals of country A, country A will have full jurisdiction. The outcome will be the same as with the Territoriality Principle, since RA maximizes the objective function (19) in both cases. This implies too lenient treatment of both FRAND commitments, since RA will disregard the implications for the profits of the producer. If instead both SEP holders are nationals of country B, country B has full jurisdiction according to the Nationality Principle. RB will then be too lenient, since it does not take into account the negative effect of the fees on consumers in country A. Hence, Proposition 2 continue to hold, slightly reworded.

But even if the findings above continue to hold for these other ownership patterns, the outcome is still qualitatively affected by the ownership pattern:

Observation 3 *The pattern of ownership affects:*
(i) the allocation of jurisdiction that stems from the Nationality Principle; and
(ii) for each allocation of jurisdiction, also the objective function(s) of the regulating authority(-ies).

5.5 Simultaneous application of both jurisdictional principles

In the view of the recent ALI Restatement (2018), there is no hierarchy among the principles in the jurisdictional default rules in current customary international law. This would imply that it is possible for several countries to simultaneously have jurisdiction over acts, persons or objects, with reference to different principles. Such overlapping jurisdiction has become more likely with the increased emphasis on the Effects Principle (see below). We will therefore examine implications of

the simultaneous application of the Territoriality and Nationality Principles, for each of the three allocations of SEP ownership that can arise in this setting.

SEP ownership split between the countries Consider first the case where the ownership of the SEPs is split among the countries. When both the Territoriality and the Nationality Principles are applicable, country A can claim jurisdiction over the FRAND commitments for both SEPs based on the Territoriality Principle as applied to the objects at issue—the patents—and country B can argue it has jurisdiction over the FRAND commitment by the nationality of the holder of SEP 2, based on the Nationality Principle as applied to the actors. There will then be overlapping jurisdiction for SEP 2, and the more stringent regulation, which will be imposed RA, will prevail. So the outcome will be $m_2 = 0$, and m_1 will be given by (13). The outcome will thus be the same as when only the Territoriality Principle is applicable.

Both SEP holders are country A nationals If both SEPs are instead owned by nationals of country A, the Nationality Principle has no bite, so the outcome when both principles are applicable is clearly the same as with only the Territoriality Principle: $m_2 = 0$, and m_1 given by (13).

Both SEP holders are country B nationals The Nationality Principle should have most bite in the case where both SEP holders are nationals of country B, since RB then has jurisdiction based on the Nationality Principle as applied to the actors. However, in this case the Territoriality Principle gives still RA jurisdiction based on the territorial application of the objects, the patents. RA will then impose maximally stringent regulation of both FRAND commitments, $m_1 = m_2 = 0$. Hence, the Nationality Principle is again irrelevant to the outcome.

Proposition 4 *The simultaneous application of the Territoriality and Nationality Principles yields the same outcome as if only the Territoriality Principle is applied, regardless of the international ownership pattern of the SEPs.*

Whenever RB has jurisdiction by the Nationality Principle, RA will also have jurisdiction by virtue of the Territoriality Principle. RA will then impose an equally, or more, stringent FRAND regulation than what RB prefers. As a consequence, the Nationality Principles becomes superfluous. Hence, *the supremacy of the Territoriality Principle that existed in earlier customary international law is de facto maintained* in the present setting.

The finding in Proposition 4 applies more broadly than the present setting might suggest. For instance, safety standards are often expressed in terms of maxima or minima, such as the maximal amount of toxic substances that foodstuffs are allowed to contain, or the minimum time a product should be able to withstand fire. When such regulations differ across countries, producers can choose to respect all of them by abiding the most stringent regulation. In these settings, as long

as the importing country sets the more stringent regulation, the Nationality Principle will not have any bite.

There are also circumstances where the exporting country will prefer more stringent regulation. A natural case is where production gives rise to local emissions in the exporting country. As long as these emissions do not affect the importing country, it will prefer to leave them unregulated, to keep the price of the product as low as possible. But both principles would in this case give the exporting country jurisdiction, so the Nationality Principle would again have no bite.

6 Non-discrimination obligations

In the setting were are considering, efficiency requires that the license fees are identical, due to the completely symmetric way in which they affect the producer, and joint welfare. However, several of the equilibria that were derived above feature some form of differential enforcement of the FRAND commitments for the SEP holders. This raises the question of whether the outcome would be better if some form of non-discrimination requirement were imposed?

For a non-discrimination obligation to have a bite, three conditions must be simultaneously fulfilled:

- the SEP holders have *different nationalities*, or they would not be treated differently;
- some authority must regulate *more than one* SEPs*;* and
- this authority treats a foreign-owned patent *less favorably* than a patent with a domestic holder.

Such situations can arise in some, but not all, of the settings considered above. There are two types of non-discrimination clauses in trade law that could be of relevance. As will be shown, these concepts provide mechanisms that can improve the properties of the Territoriality and Nationality Principles, and also of an extreme form of the Effects Principle.

6.1 The Territoriality Principle with a National Treatment obligation

When a patent-issuing country has jurisdiction the enforcement of both FRAND commitments by virtue of the Territoriality Principle, it will discriminate based on the *nationality* of the SEP holders. Differential enforcement of FRAND commitments might violate international agreements, however. Most countries are bound by the *Paris Convention for the Protection of Industrial Property*, which covers patents, which in Art. 2 includes a *National Treatment* (NT) provision:

> Nationals of any country of the Union shall, as regards the protection of industrial property, enjoy in all the other countries of the Union the advantages that their respec-

> tive laws now grant, or may hereafter grant, to nationals... they shall have the same protection...and the same legal remedy against any infringement of their rights....

It seems plausible that more stringent treatment of a foreign-owned than of an otherwise completely symmetric domestically-owned SEP could violate this stipulation. Most countries are also members of the WTO, and are therefore legally bound to respect the *Agreement on Trade-Related Apects of Intellectual Property Rights* (TRIPS Agreement). The applicability of the TRIPS Agreement to the enforcement of SEP commitments has not been tested yet in case law. However, the agreement was invoked for the first time in February 2022 in a dispute regarding FRAND-related issues. In this dispute, the EU alleges that China violates the TRIPS Agreement through its enforcement of FRAND commitments for EU patent holders in China.[24,25] Also, it seems likely that a main component of any international agreement on FRAND enforcement would be some form of NT provision. We will therefore consider implications of such a clause.[26]

Assume that the ownership of the SEPs is split between the countries, and that jurisdiction is allocated to RA by virtue of the Territoriality Provision. Absent a non-discrimination obligation, RA would set $m_2' = 0$, and $m_1' < r^0$ as given by (14). The difference in the regulated levels would thus be $m_1 - m_2 = m_1' > 0$. Now impose an NT obligation that requests RA to reduce this gap. To abide by the NT rule, RA could either reduce m_1, increase m_2, or use some combination of the two. A marginal reduction in m_1 will not have any first-order effect at $(m_1', 0)$ since $V_1^A(m_1', 0) = 0$. But increasing m_2 will have a negative first-order effect equal to $(-D + \alpha r' D_p)P_2 < 0$. Hence, RA's optimal adjustment to a *slightly* binding NT rule would be to mainly reduce m_1. This rule will be desirable from a joint efficiency perspective, due to the reduction in r_1:

$$W_1 = V_1^B < 0.$$

Faced with the imposition of a *strict* NT rule that requests equal regulation of the two FRAND commitments, RA has two options.[27] One option is to regulate both commitments. This requires equal treatment: $m_1 = m_2 = m''$. If $\alpha > 2P_i(0,0)$, there will be an interior solution to RA's problem, given by the solution to

$$\begin{aligned} V_1^A(m'', m'') + V_2^A(m'', m'') &= -2DP_i + \alpha[D + 2m''D_pP_i] \\ &= 0. \end{aligned} \tag{20}$$

[24] According to the EU's Request for Consultation, China "...prohibits patent holders from asserting their rights in other jurisdiction by commencing, continuing and enforcing the results of legal proceedings before a non-Chinese court" (www.wto.org, WT/DS611/1).

[25] There is also an NT provision in Art. 3 TRIPS, but it is not clear that it is applicable to FRAND enforcement. NT provisions regarding intellectual property rights are also almost invariably included in other major trade agreements.

[26] The economic literature on NT is very meagre in general. There are a few papers that consider the role of NT in trade agreement; see Horn (2006), Saggi and Sara (2008), and Horn, Maggi and Staiger (2011).

[27] We disregard the fact that National Treatment provisions normally are expressed as weak inequalities, such as "treatment no less favorable than...".

In the opposite case RA will prefer the corner solution $m_1'' = m_2'' = 0$.

The other option for RA would be to abstain from regulating the FRAND commitment for SEP 2, which would then remain unregulated. RA would then set the m_1' that solves

$$V_1^A(m_1', N^2(m_1')) + V_2^A(m_1', N^2(m_1'))N_1^2(m_1') = 0, \tag{21}$$

in awareness of the fact that the choice of m_1 will affect also r_2. This second option is more attractive for RA, the more weight it puts on the license revenue of SEP 1, since it allows RA to be less restrictive vis-à-vis the holder of SEP 1. It is ambiguous whether this is better or worse for RA than regulating both FRAND commitments, however.

The welfare implications of the strict NT obligation are thus ambiguous in general, and partly depend on the extent to which the interests of RA are aligned with those of RB. On the one hand, imposing strict NT can yield the fully efficient outcome. To see this, note that at an interior solution $m_1 = m_2 = m''$, as defined in (20),

$$\begin{aligned} \frac{d}{dm}W(m'', m'') &= -2\gamma D + \alpha D + 2\alpha m'' D_p P_i \\ &= 2(P_i - \gamma)D, \end{aligned}$$

using the first-order condition for m'' above. The Territoriality Principle coupled with strict NT will hence lead to too lenient enforcement of the FRAND commitments if $P_i < \gamma$, and to too restrictive enforcement in the opposite case. In particular, if $P_i = \gamma$, RA will behave is if it were maximizing joint welfare.

Intuitively, when RA imposes a uniform regulation on both FRAND commitments it will implicitly take full account of the effect on the license revenue for SEP 2, since it will be the same as the effect on the revenue of SEP 1 due to the symmetry of the setting. What will matter for whether there is too lenient or stringent enforcement is the extent to which RA's concern for consumer welfare matches RB's concern for producer welfare. The implication for RA of a marginal increase in $m_1 = m_2$ that stems from reduce consumer welfare is $-2DP_i$, and the implication for RB's interest in profits of its producer is $-2\gamma D$. Hence, when $P_i = \gamma$, RA's marginal incentives are perfectly aligned with those of RB, and the efficient regulation is imposed. Coupling the Territoriality Principle with a strictly binding NT obligation hence normally has ambiguous implications for joint welfare. Indeed, it is even possible that this will reduce welfare relative to just imposing the Territoriality Principle.

Proposition 5 *If the SEP holders have different nationality, and jurisdiction is determined according to the Territoriality Principle:*
(i) Imposition of a marginally binding NT provision will improve joint welfare.
(ii) Imposing a strictly binding NT obligation can implement full efficiency, but can also reduce joint welfare.

6.2 The Nationality Principle with a "consistency" requirement

The Nationality Principle only gives the regulatory authorities jurisdiction over the enforcement of FRAND commitments of their domestic SEPs. Since the authorities under this principle do not regulate foreign SEPs, there cannot be less favorable treatment of foreign SEPs in the *de jure* sense. Hence, an NT obligation will not have any bite. However, if the setting is extended to include more than one industry, a natural rationale for differential treatment arises also with the Nationality Principle.

To illustrate, assume that there are two industries, an industry X that is identical to the one examined above, and an industry Y that is a mirror image of X with the roles of the countries reversed. Hence, each country is the producer of one product and the consumer of another product. The two industries are economically separate. Production in industry X draws on two SEPs, the country A-owned X1 and the country B-owned X2, and production in industry Y uses the country A-owned Y1 and the country B-owned Y2.

If these two industries were both part of an the integrated economy, the regulatory authority in this economy would treat all FRAND commitments identically due the complete symmetry of the setting. But when this integrated economy is split into two mirror images, the national regulatory authorities will typically want to treat their two national SEP holders differently, *depending on whether the SEP is used in the export or import industry.* There would thus again be differential treatment of SEP holders that stem from the international dimension, and it could be considered as discriminating against foreign SEP holders if countries adopt more stringent interpretation of FRAND commitments in their import industries than in their export industries. .

The WTO Agreement includes in one of its special agreements a requirement to treat risks in a *consistent manner* across different situations:

> ...each Members shall avoid arbitrary or unjustifiable distinctions in the levels [of risk] it considers to be appropriate in different situations, if such distinctions result in discrimination or a disguised protection of international trade...[28]

The idea is hence that the regulatory regime should not be adapted to different regulatory issues in order to promote trade interests.

Applying a similar type of consistency requirement to the present setting, consider the implication of an obligation for the countries to enforce FRAND commitments in the same manner regardless of the sector where they are used. RA will then impose a regulation $m^A_{X1} = m^A_{Y1} = m^A$ that for $m^B_{X2} = m^B_{Y2} = m^B$ solves

$$\max_{m^A} \; U^X(m^A, m^B) + \alpha L^{X1}(m^A, m^B) + \alpha L^{1Y}(m^A, m^B) + \gamma \Pi^Y(m^A, m^B),$$

[28] Art. 5.5 of *The Agreement on the Application of Sanitary and Phytosanitary Measures.*

where the first two terms is the welfare derived from the X industry, and the second two terms that derived from the other industry. RB would solve the corresponding problem. Note that due to the assumed full symmetry of the setting, the regulatory authorities would now effectively maximize joint welfare, and the outcome would then be *fully efficient*, as in the integrated economy.

Intuitively, absent the consistency requirement, the two industries are economically separate, implying that the authorities decision problem for one industry is fully separate from that for the other industry. But the NT obligation bundles the two decision problems. Of course, each authority still disregards the impact of its decision for the other country. But with the obligation each authority will take into account the effects of its decision both with regard to the industry where it is an importer and where it is an exporter. When the countries are mirror images each regulatory authority will effectively maximize welfare with respect to the instrument it controls for an economy that is a replica of the other country. Full efficiency requires of course that the countries are mirror images. But the mechanism will be at play also in more asymmetric settings, although there full efficiency will not be achieved in that case.

Proposition 6 *A Nationality Principle that is supported by a consistency requirement that prevents differential treatment of FRAND commitments in different industries, can implement the jointly efficient outcome if countries are symmetric.*

6.3 The Effects Principle with a National Treatment obligation

The Territoriality and Nationality Principles are the two classic bases for jurisdiction. Another base that is increasingly referred to, not least in the area of antitrust, is the Effects Principle. It gives countries jurisdiction to regulate when they are exposed to effects from abroad. The principle is therefore often qualified to apply in cases where the effects involved "substantial." This is necessary from an economic point of view, since in an economic system, almost any decision in one country will affect all other countries, even if the effects are very small and hard to measure. The problem is however, that it is unclear should be meant with "substantial."

In the present setting, both countries could be exposed to effects from the respective foreign-owned SEP that potentially could be accepted as substantial. Country A could argue that the objective for the regulation of FRAND commitments, in particular if undertaken through antitrust, is consumer protection, that the substantial effects from violations of FRAND commitments therefore appear in country A, and that it consequently should have jurisdiction. Country B could point to the importance of the SEPs for its export industry, and claim that FRAND enforcement is not of concern only for ultimate consumption; indeed, countries such as China, South Korea and Taiwan appear to have argued along the latter line in actual cases. It therefore seems plausible that both countries can claim jurisdiction based on the Effects Doctrine. This is why we have refrained from making the Effects Principle part of the main analysis. We will here nevertheless assume that the Effects Principle does give both countries jurisdiction over the enforcement of FRAND commitments

for both SEPs, since this helps illuminate a subtle implication of the National Treatment obligations that will likely be at play also with more sophisticated interpretations of the Effects Principle.

Assume that the ownership of the SEPs is split between the countries. When both countries can exercise jurisdiction over both FRAND commitments, each authority will set the license fee for foreign-owned SEP to its minimal level—*each authority will hence discriminate.* But since the more stringent of the regulations will bind when they are overlapping, the implemented outcome will be non-discriminatory: $\mathbf{r} = (m_1^B, m_2^A) = (0, 0)$.

Observation 4 *When the Effects Principle yields overlapping jurisdictions, both regulations will be discriminatory, but the policy treatment will be the same for the SEP holders.*

Consider now the imposition of a strict NT obligation that requires each authority to impose the same regulation on both SEPs; the two authorities hence set m^A and m^B, respectively. The lower of m^A and m^B will be the binding regulation for both SEPs, provided that it is low enough to be implementable through the license fee negotiations. RA's optimal regulation is given by an identical expression to (20). Evaluating such an expression at RA's optimal regulation absent the NT obligation, m_1':

$$\begin{aligned} \frac{d}{dm}V^A &= V_1^A(m_1', m_1') + V_2^A(m_1', m_1') \\ &< V_1^A(m_1', 0) + V_2^A(m_1', m_1') \\ &= V_2^A(m_1', m_1') < 0, \end{aligned}$$

where the inequality follows from the assumption $V_{12}^A < 0$. The NT obligation will hence induce RA to prefer more stringent FRAND enforcement for its domestically owned SEP, and less stringent regulation of the SEP with a country B holder. The same considerations apply to RB.

To see the implications of the NT obligation for aggregate welfare, assume that it is RA that prefers the more stringent regulation, $m^A < m^B$. It must then be that

$$\begin{aligned} \frac{d}{dm}W(m^A, m^A) &= \frac{d}{dm}[V^A(m, m) + V^B(m, m)] \\ &= \frac{d}{dm}V^B(m^A, m^A) > 0, \end{aligned}$$

where the inequality sign follows from the assumption that $m^A < m^B$, and that m^B is optimal for RB. The same reasoning applies in case $m^A > m^B$.

That is:

Proposition 7 *If the Effects Principle awards both countries jurisdiction over both FRAND commitments:*

(i) License fees will be regulated to minimal levels absent a National Treatment obligation.

(ii) With a National Treatment obligation regulations will be more lenient, but still be too restrictive, and joint welfare will be higher.

7 Concluding discussion

International law requires countries to respect the default rules for jurisdiction absent international agreements. These rules are crucial in almost every area of international interaction, including in the economic sphere. But the rules have still been subject little (if any) systematic economic analysis, to the best of our knowledge. The purpose of this paper has been to initiate the study of the ability of these rules to address international externality problems that arise from unilateral enforcement of FRAND commitments.

The paper is based on the notion that countries will have different interests with regard to enforcement of FRAND commitments for SEPs when they are engaged in different parts of global production chains. The purpose of the paper is analyze how the two main jurisdictional principles in customary international law, based on territoriality and nationality, perform in various settings.

Broadly speaking, the findings suggest that the default rules should not be expected to fully address the inefficiencies that arise due to the unilateral regulation. These rules allocate jurisdiction, but they *do not address the source of the externality problems*: the unilateral decision making regarding enforcement of FRAND commitments. Another weakness of the rules is that they *allow countries to purse discriminatory regulation*, even though this is inefficient from a joint welfare perspective. The paper identifies several mechanisms through which non-discrimination obligations might improve matters. But the findings nevertheless suggest that even when extended in this way, existing law does not suffice to resolve the problems that stem from national enforcement of FRAND commitments in an economically efficient manner. This suggests the need for some form of internationally negotiated solution.

International comity agreements constitute steps toward more cooperative regulation. There are a few examples of such agreements in other areas of competition law. However, apart from the inherent problem of determining which party has the "greater interest," comity agreements have the drawback of allocating jurisdiction to the party with the larger *unilateral* interest, not to the party that will implement the jointly more efficient outcome. There are therefore limits to the extent to which such agreements can improve upon the outcome.

A more direct way of addressing the problem would be to negotiate an international agreement on what constitutes reasonable license fees, or how they are to be calculated. As mentioned, non-discrimination would presumably be a central component of such an agreement. While inspiration can be taken from existing clauses in other international economic integration agreements, such provision(s) would have to adopted to the specific issues at hand in the case of enforcement of FRAND commitments, as was seen above. It seems unlikely however that the major economies could reach such an agreement anytime soon, with their widely different views on how to enforce

these commitments, and their different commercial interests. It thus looks like the world will be stuck with the current type of conflicts for the foreseeable future.

A Appendix

The following example shows that some of the assumptions in the main text can be internally consistent.

Let gross consumer be $\tilde{U}(c) \equiv c - \frac{1}{2}c^2 + y$,where $0 < c < 1$ is consumption of the product of interest, and y is consumption of an outside product. The associated demand is $D(p) = 1-p > 0$ for $p < 1$. For given license fees $r_i < \frac{1}{2}$, the optimal producer price is $P(\mathbf{r}) \equiv \arg\max_p (p-r_1-r_2)(1-p) = \frac{1}{2}(1 + r_1 + r_2)$ since the second-order condition is always fulfilled. Also, $P_i = \frac{1}{2} < 1$, consistent with (1). The maximized profit and license revenues are

$$\Pi(\mathbf{r}) = \frac{1}{4}(1 - r_1 - r_2)^2 \text{ and } L^i(\mathbf{r}) = \frac{1}{2}r_i(1 - r_1 - r_2).$$

The negotiated license fees are given by the first-order conditions $\frac{d}{dr_i}[L^i(\mathbf{r})\Pi(\mathbf{r})] = 0$. Since $\max(r_1, r_2) = \frac{1}{4}$, the second-order conditions hold:

$$\frac{d^2}{dr_i^2}[L^i(\mathbf{r})\Pi(\mathbf{r})] = -\frac{3}{4}(1 - 2r_i - r_j)(1 - r_i - r_j) < 0.$$

The first-order conditions define best reply functions for the two negotiations:

$$N^i(r_j) = \frac{1}{4}(1 - r_j).$$

Hence, consistent with assumptions (3) and (5),

$$\left.\frac{dr_2}{dr_1}\right|_{N^1} = -4 < \left.\frac{dr_2}{dr_1}\right|_{N^2} = -\frac{1}{4} < 0,$$

The symmetric unregulated market outcome is given by $r = \frac{1}{4}(1 - r)$, and is hence $\mathbf{r}^0 = (\frac{1}{5}, \frac{1}{5})$. Since $1 - 2r_i - r_j$ is maximized for $r_i = r_j = \frac{1}{5}$, in which case it is negative, the second-order conditions for the bargaining problem are fulfilled. To avoid less interesting corner solutions, assume that $\alpha \in (\frac{1}{2}, \frac{3}{2})$, and set $\gamma = 0$. With $W_{ii} = 1-4\alpha$, the second-order conditions for the maximization of the integrated economy welfare are fulfilled. The solution to the first-order conditions $W_i(r, r) = 0$ is

$$r^J = \frac{1}{4}(\frac{\alpha - \frac{1}{2}}{\alpha - \frac{1}{4}}) \begin{cases} > 0 \\ < \frac{1}{5} \end{cases}$$

Hence, $0 < r^J < r^0$ as assumed in (9). The assumed range of α also ensure that $V_{12}^A = \frac{1}{4}(1-2\alpha) < 0$, as assumed in (**??**).

References

ALI (1987). *Restatement (Third) Foreign Relations Law of the United States.* American Law Institute, Philadelphia, USA.

ALI (2018). *Restatement (Fourth) Foreign Relations Law of the United States.* American Law Institute, Philadelphia, USA.

Auer, Dirk and Geoffrey Manne (2019). Is European Competition Law Protectionist? A Quantitative Analysis of the Commission's Decisions. ICLE Antitrust & Consumer Protection Program Issue Brief 2019-03-25.

Bradford, Anu, Robert J. Jackson Jr., and Jonathon Zytnick (2017). Is EU merger control used for protectionism? An empirical analysis. *Journal for Empirical Legal Studies* 14(4), December.

Choi, Jay P. (2014). FRAND royalties and injunctions for standard essential patents. CESIfo Working Paper Series No. 5012.

Contreras, Jorge L. (2019). Technical standard, standards-setting organizations and intellectual property: a survey of the literature (with an emphasis on empirical approaches). In Menell, Peter S. and David Schwartz (eds), *Research Handbooks on the Economics of Intellectual Property Law, Vol 2 - Analytical Methods,* Edward Elgar. SSRN: https://ssrn.com/abstract=2900540

Contreras, Jorge L. (2021). Anti-Suit Injunctions and Jurisdictional Competition in Global FRAND Litigation: The Case for Judicial Restraint. *Journal of Intellectual Property and Entertainment Law* 11(2).

de Rassenfosse, Gaétan, Paul H. Jensen, T'Mir Julius and Elisabeth Webster (2019). Are foreigners treated equally under TRIPS? *The Journal of Law and Economics* 62(4), 663-685.

de Rassenfosse, Gaétan and Emilio Raiteri (2022). Technology protectionism and the patent system: Evidence from China. *The Journal of Industrial Economics* LXX(1), 1-43.

Drahozal, Christopher R. (2014). Some observations on the economics of comity. In Eger, Thomas and Stefan Voigt (eds) *The Economic Analysis of International Law,* Mohr Siebeck. Available at SSRN: https://ssrn.com/abstract=2101400.

Erixon, Fredrik and Matthias Bauer (2017). Standard essential patents and the quest for faster diffusion of technology. ECIPE Policy Brief No. 4.

Froeb, Luke M., Bernard Ganglmeir, and Gregory J. Werden (2012). Patent hold up and antitrust: how a well-intentioned rule could retard innovation. *Journal of Industrial Economics* 60(2), 249-273.

Geradin, Damien (2020). SEP Licensing After two Decades of Legal Wrangling: Some Issues Solved, Many Still to Address. TILEC Discussion Paper No. DP2020-040.

Horn, Henrik (2006). National Treatment in the GATT. *American Economic Review* 96(1), 394-404.

Horn, Henrik, Giovanni Maggi and Robert W. Staiger (2010). Trade agreements as endogenously incomplete contracts. *American Economic Review* 100(1), 394-419.

Horn, Henrik and Asher Wolinsky (1988). Bilateral monopolies and incentives for merger. *RAND Journal of Economics* 19, 408-419.

Hovenkamp, Herbert (2020). FRAND and antitrust. *Cornell Law Review* 105(6). https://ssrn.com/abstract=3420

Langus, Gregor, Vilen Lipatov and Damien J. Neven (2013). Standard-essential patents: Who is really holding up (and when)? *Journal of Competition Law and Economics,* 253-284.

Langus, Gregor and Damien J. Neven (2021). Ex ante competition for patents reading on mobile standards. A dynamic perspective. Mimeo, May.

Layne-Farrar, Anne (2017). The economics of FRAND. In Blair, Roger D. and D. Daniel Sokol (eds), *The Cambridge Handbook of Antitrust, Intellectual Property, and High Tech,* Cambridge University Press, 58-78.

Lerner, Josh and Jean Tirole (2015). Standard-essential patents. *Journal of Political Economy* 123(3), 547-586.

Lundstedt, Lydia (2016). *Territoriality in Intellectual Property Law.* Department of Law, Stockholm University.

Mariniello, Mario, Damien Neven, and Jorge Padilla (2015). Antitrust, regulatory capture, and economic integration. E15Initiative. Geneva: International Centre for Trade and Sustainable Development and World Economic Forum.

Nicolic, Igor (2022). Comments on the Draft Policy Statement on Licensing Negotiations and Remedies for Standard-Essential Patents Subject to F/RAND Commitments. Manuscript, Feb. 3.

Padilla, Jorge, Douglas H. Ginsburg, and Koren W. Wong-Ervin (2018). Antitrust analysis involving intellectual property and standards: implications from economics. *George Mason Law Review* 26(2). https://www.ftc.gov/system/files/documents/public_comments/2018/08/ftc-2018-0055-d-0003-147694.pdf.

Saggi, Kamal and Nesa Sara (2008). National Treatment in the WTO: The roles of product and country heterogeneity. *International Economic Review* 49(4), 1365-1394.

Spulber, Daniel F. (2019). Licensing standard essential patents: bargaining and incentives to invent. Available at https://ssrn.com/abstract=3338997.

Webster, Elisabeth, Paul H. Jensen and Alfons Palangkaraya (2014). Patent examination outcomes and the Nationality Principle. *The Rand Journal of Economics* 45(2), 449-469.

Wong-Ervin, Koren and Andrew J. Heimert (2021). Extraterritoriality: Approaches around the world and model analysis. In Nicolas Charbit (ed), *Eleanor M. Fox Liber Amicorum*, Concurrence.

Wong-Ervin, Koren W., Joshua D. Wright, Bruce H. Kobayashi, and Douglas H. Ginsburg (2016). Extra-jurisdictional remedies involving patent licensing. *Competition Policy International* 12(2). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2870505.