This article takes an axiomatic approach to determining “Fair, Reasonable, and Non-Discriminatory” (“FRAND”) royalties for intellectual property (“IP”) rights. Drawing on the extensive game theory literature on “surplus sharing/cost sharing” problems, I describe specific formulas for determining license fees that can be derived from basic fairness principles. In particular, I describe the Shapley Value, the Proportional Sharing Rule and the Nucleolus. The Proportional Sharing Rule has the advantage that it is the only rule that is invariant to mergers and splitting of the IP owners. I also explain why, at times, there may be no acceptable solution. Further, I contrast these rules with the Efficient Component Pricing Rule (“ECPR”) suggested by Baumol and Swanson. Unlike, the ECPR, the rules identified in this article can uniquely determine license fees when there is more than one owner of essential IP, and also incorporate various notions of fairness and equity.

Keywords: efficient component pricing rule; FRAND; game theory; intellectual property rights, proportional sharing rule, Shapley Value

INTRODUCTION

Owners of intellectual property (“IP”) are asked or required to agree to Reasonable and Non-Discriminatory or Fair Reasonable and Non-Discriminatory (“FRAND”) royalty rates as a condition for inclusion of their IP in a standard. I provide a formulaic interpretation of different FRAND principles or axioms. This article informs policy decisions in at least three ways: (1) by providing specific formulas, each based on a set of fairness axioms, (2) showing how the solution for determining FRAND royalty rates depends on the specific axioms chosen and (3) explaining the implications of policy decisions setting royalty rates or to impose specific fairness principles in how royalty rates should be set.

The particular aim of the article is to provide specific formulas based on fairness axioms for dividing the surplus arising from an allocation of rights to multiple patents among the patents’ owners. Most of what follows applies these principles applied to a situation in which there are at least two IP owners, and one or more licensees. However, the same principles can
be applied to the case in which there is only one upstream IP owner. I present a number of different specific royalty sharing arrangements each based on a specific set of fairness axioms. This article does not address the related issue of what are profit-maximizing royalty rates for the IP owners to charge, nor how a fair allocation of royalties is to be realized.

The issue of how to determine FRAND royalties has been addressed in a number of recent papers. These recent papers have tended to focus on a single solution. However, as explained below, the game theory literature shows that there can be many different solutions, or no solution, to what is fair depending on what fairness principles are assumed. In particular, I explain how that even the most basic fairness principles cannot always be satisfied in some circumstances. Moreover, I show that imposing too many requirements can lead to conflict.

A couple of recent papers have applied two game theoretic solution concepts to the problem of determining FRAND royalty rates. Baumol and Swanson (2005) have suggested applying the “Efficient Component Pricing Rule” (“ECPR”) to the determination of the royalty rates. Baumol and Swanson argue that ECPR will result in efficient allocations and assignment of IP rights. Layne-Farrar, Padilla and Schmalensee (2006) have suggested a different rule, the Shapley Value. The ECPR and the Shapley Value are but two of a class of solutions to what is called “surplus sharing games.”

More specifically, a surplus sharing game is a set of “players”, that is, the participants in the negotiation process to set royalty rates, a function describing the surplus that each subset of players, as well as the coalition of the whole, can create. In other words, a surplus sharing game is a description of the total profits available, as well as the profits any subset of players can assure themselves on their own. A “solution” to a surplus sharing game is a rule for allocating surplus among the players.

The Shapley Value is one such solution. In particular, the Shapley Value allocates a unique set of payoffs, or an essentially unique set of royalty rates. The ECPR is another, partial, solution, in that it specifies a set of royalty rates that satisfy one efficiency axiom. This article describes other sets of fairness axioms that can be applied to determine FRAND royalties. I show how different sets of axioms will result in different algebraic formulas for determining royalty rates.

I also show how the allocation of surplus can be quite sensitive to the particular fairness axioms being applied. I provide a number of examples showing that, at times, no allocation can satisfy all the desired fairness requirements. This means analysis that conflicts can arise between different sets of fairness criteria. In such cases, a decision about what constitutes FRAND royalty rates necessarily involves a decision about which fairness criteria matter more than others. There may be no solution to the problem of determining FRAND royalties if the solution must satisfy too many axioms.

This article relies heavily on two survey papers, one by H. P. Young (1994) on cost allocation and the other by H. Moulin (2002) providing an axiomatic analysis of cost and surplus sharing “games”. Most of the economics literature focuses on the cost allocation problems, that is, how a joint and common cost of a project should be fairly allocated among the set of beneficiaries of the project. However, as Moulin explains, much of the analysis of cost allocation problem applies to surplus sharing problems. In contrast, the allocation problem of a surplus sharing game is to fairly divide the benefits of a project.
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