

DEPARTMENT OF ECONOMICS AND FINANCE
SCHOOL OF BUSINESS AND ECONOMICS
UNIVERSITY OF CANTERBURY
CHRISTCHURCH, NEW ZEALAND

**Bargaining Theory and the Copyright Royalty Board's Rate
Setting Mandate for Interactive Streaming of Music**

**Elliott Hughes
Richard Watt**

WORKING PAPER

No. 4/2023

**Department of Economics and Finance
UC Business School
University of Canterbury
Private Bag 4800, Christchurch
New Zealand**

WORKING PAPER No. 4/2023

Bargaining Theory and the Copyright Royalty Board's Rate Setting Mandate for Interactive Streaming of Music

Elliott Hughes¹
Richard Watt

May 2023

Abstract: In the USA, the remuneration for songwriters whose copyrighted material is broadcast using online interactive music services is subject to a compulsory license with a rate that is regulated by the Copyright Royalty Board (CRB). On the other hand, an essentially equally necessary input to the interactive music services, namely the sound recording copyright, is fully and freely negotiated between the parties. This situation sets up an interesting bargaining problem that should be of great interest to the CRB for their statutory mandate. The present paper sets out this problem formally, and resolves the equilibrium outcomes. The model is calibrated with the actual rates that have been set recently by the CRB.

Keywords: Bargaining theory, regulation of copyright remuneration, Copyright Royalty Board USA

JEL Classifications: D, D04, D45

¹ Department of Economics and Finance, University of Canterbury, NEW ZEALAND

† Corresponding author: Richard Watt. Email: richard.watt@canterbury.ac.nz

Bargaining Theory and the Copyright Royalty Board’s Rate Setting Mandate for Interactive Streaming of Music

1. INTRODUCTION

Following a landmark case over 110 years ago, the US Supreme Court judged that the “mechanical” copyright for reproductions of copyright protected works should be made available under a compulsory license.¹ Under this compulsory license, the amount of the associated fees paid to the copyright owner is set by statute,² which more recently has been effected by the Copyright Royalty Board (CRB). The regulatory oversight that Congress thus has over the compensation for the mechanical license remains in place today, even though the media upon which reproduction occurs is now vastly different from that which originally inspired its need, although the subject matter remains the reproduction of a musical work. It is worthwhile to point out the impressive importance of the task of the CRB. Quite literally, the survival of the US songwriting industry, along with the livelihoods of countless thousands of creative songwriters depends critically upon the CRB’s decisions. According to the most recent statistics of the RIAA, the total revenue of subscription music streaming in USA in 2022 amounted to \$10.2 billion dollars,³ and so the CRB has the ability to effect swings in remuneration of the parties of hundreds of millions of dollars.

In order for pre-recorded music to be reproduced, broadly speaking it is necessary to clear two very different, but at the same time remarkably similar, copyrights. The first, known as the “sound recording” copyright, allows the reproduction of the sounds that are contained on the musical recording. The sound recording copyright, at least in modern times, is typically owned by a recording company (most normally, a record “label”). The second copyright to be cleared is the “musical works” copyright, which entails as a sub-right, the mechanical right. The musical works copyright is typically owned by the songwriter of the music concerned, and is generally exploited on the owner’s behalf by a music producing company. It is, therefore, the case that the two copyrights, which are different because they protect different elements of pre-recorded music and because they may be owned and managed by different individuals, are also similar in the sense that they are equally necessary if the music is to be reproduced. In common economic parlance, the sound recording and the musical works copyrights are perfect complements. However, due to the 1909 Supreme Court decision, one of them has its price fixed by a regulator (and is subject to compulsory licensing), while the other is freely negotiated by the copyright owner and the copyright user. Thus, the Supreme Court unwillingly gave rise to a very interesting set of related problems in bargaining theory; How does the statutory mechanical rate affect the negotiated sound recording rate? What are the effects on the sound recording bargaining problem of different possible structures of the regulated rate? Who are the winners and who are the losers when different regulated rate structures are considered? The present paper looks at these issues within a standard Nash bargaining model.

¹The mechanical copyright differs from the public performance copyright, which interactive streaming services must also pay to the musical works copyright owners. The public performance copyright refers to the right to perform a musical composition in public (including to a single streaming consumer), while the mechanical copyright refers to the right to reproduce the composition through a recording mechanism. Digital interactive streaming of music does involve a digital copy of the music that is streamed being saved digitally to the hardware involved. Since these two royalty streams are generated together, they are normally treated as an “all-in” royalty paid to copyright owners. See, for example, <https://soundcharts.com/blog/performance-royalties-vs-mechanical>

²See the Copyright Act 1909. See also, for example, the discussion in Landau (2000). A short timeline of major revisions to the act over the first 40 years or so is available on https://www.copyright.gov/timeline/timeline_1900-1950.html. The most recent relevant law is the Musical Works Modernization Act of 2018.

³See <https://www.riaa.com/wp-content/uploads/2023/03/2022-Year-End-Music-Industry-Revenue-Report.pdf>

The paper is structured as follows. In section II, a brief outline of the situation to be studied is set down. Section III then establishes the bargaining model, complete with a full discussion of the inputs to that model, including a very general form for the regulated musical works rate. Section IV solves the bargaining problem, and points out a set of very interesting results that the problem delivers. Section V concludes.

2. RE-PRODUCTION OF MUSIC IN MODERN TIMES IN USA

Since about a decade ago, the primary means by which consumers access music in most developed countries, including USA, is via internet streaming services such as Spotify.⁴ These services differ from what came before them (e.g. CD Roms and digital downloads, to name the most recent technologies), in that the music that is heard is never actually owned in any way. The services operate on a subscription model, whereupon consumers pay a monthly fee, and in exchange can hear essentially any song or musical composition in existence, as often as they like, with the only real criteria being that the song exists in a pre-recorded format. In order to provide that service, it is necessary to clear a large array of different copyrights, including the right to perform the music publicly and the right to broadcast the music over a media. But for each song that is requested by a consumer, and duly supplied to them to listen to, a digital copy is saved in cache, and so each performance and broadcast of a song by an internet music streaming company also entails a recording being made of that song. Therefore, the license to the recording copyrights (for our purposes, the sound recording right, and the mechanical right, which in turn we will simply identify as the musical works right⁵), must also be cleared.

The United States of America is different from almost every other nation in regards the copyright licensing arrangements that music streaming services face. In USA, the mechanical right is subject to compulsory licensing at a rate that is set by statute. The regulatory body with the mandate to set that rate is the Copyright Royalty Board (CRB), and it does so using a 5-year window system. The CRB sets both the structure of the rate (i.e. the formula under which the exact rate is calculated), and the parameters that populate that structure. Importantly for the present article, there are a few particular features of recent regulated rates that deserve mention. First, the rate has normally involved several structure “prongs”, that is, different calculations, each set in motion depending on the outcomes of particular variables. Second, two of the main prongs that are habitually in use are (i) a rate set as a fraction of total revenue of the streaming service, and (ii) a rate set as a fraction of the negotiated sound recording rate.⁶ Specifically, in the latest few determinations of the CRB, the principal rate calculation involved calculating a payment based on a fraction of streaming service revenue, and calculating a payment based on a fraction of the negotiated sound recording rate (also a fraction of revenue), and setting as the payment due the greater of those two calculations.⁷

We study here the bargaining problem between a music streaming service and a sound recording copyright holder (normally a record label). Exogenous to, but clearly affecting, that bargaining problem is the structure and value of the rate that is set by the CRB for the regulated musical works license. Thus, by backward induction, the CRB is able to influence the outcome of the label-service bargain. This introduces interesting

⁴In the USA, and in many other countries as well, important music streaming services are also offered by Amazon, Google, and Apple, as well as a great many smaller companies.

⁵The mechanical right is only a part of the musical works right. Also included in musical works is a right to performance. However, it is habitual that the regulator establishes an “all in” rate for the total musical works license, by essentially establishing that the mechanical rate will equal some number less what is negotiated as the song-writers’ performance right.

⁶Another often used “back-stop” prong sets a rate per-subscriber.

⁷The final determination for the 2018 proceedings (which were upheld in the remand) can be found at <https://www.federalregister.gov/documents/2019/02/05/2019-00249/determination-of-royalty-rates-and-terms-for-making-and-distributing-phonorecords-phonorecords-iii>. The rates for the 2023-27 period are set forth in the final determination, which can be found at www.govinfo.gov/content/pkg/FR-2022-12-30/pdf/2022-28316.pdf

some economically interesting features when the proportion of revenue paid to songwriters is dependent on the outcome of the bargaining problem. We present the generalized Nash bargaining model⁸ for this problem and extend it to account for this case, then discuss the relative welfare of each group under different songwriter remuneration structures.

3. THE GENERALIZED NASH BARGAINING PROBLEM

In this section we consider the bargaining problem between a single streaming service (from here on, a “music distributor”), and a single record label. Of course, in reality there are several distributors and labels, but in the interests of tractability and to clearly highlight our main results, we only consider a single (representative) distributor and a single (representative) label. We assume a one-shot bargaining game in a setting of full and symmetric information, with risk-neutral players. We study three possible musical works remuneration structures that could be set by the CRB. Each structure leads to a slightly different Nash bargaining problem for the record label and the distributor. In all cases we have following parameters:

- The total revenue that the music distributor earns if it closes a deal with the label is a fixed amount R .
- Total non-content costs⁹ to the distributor are a fixed proportion s of revenue and total costs to the record label are a fixed proportion γ of their revenue.¹⁰
- The relative bargaining power of the distributor is π , and that of the label is $(1 - \pi)$, where $0 < \pi < 1$.

The distributor and the record label bargain over σ , the proportion of revenues which are allocated as royalties to the label. Thus the general Nash bargaining problem becomes

$$\max_{\sigma} N(\sigma, m(\sigma))$$

where

$$N(\sigma, m(\sigma)) = (R - sR - \sigma R - m(\sigma)R)^{\pi} (\sigma R(1 - \gamma))^{1 - \pi}$$

and $m(\sigma)$ is the proportion of revenues allocated by the regulator to the songwriters to cover for the musical works copyright. Note that since every term is multiplied by R , without loss of generalization, we can normalize to $R = 1$, so that this problem becomes easily reducible to

$$\max_{\sigma} N(\sigma, m(\sigma)) = (1 - s - \sigma - m(\sigma))^{\pi} (\sigma(1 - \gamma))^{1 - \pi}$$

Our interest is to consider how different musical works payment functions, $m(\sigma)$, affect this bargaining problem.

To begin with, assume $m(\sigma)$ is everywhere differentiable with $m'(\sigma) \geq 0$ and $m''(\sigma) \geq 0$. These assumptions are perhaps artificial, but hold for the contracts under discussion and ensure that the problem remains well behaved. Thus we obtain

⁸The seminal paper on bargaining, by Nash (1950), did not include explicit bargaining powers of the players. Nash’s model was later generalized to include bargaining powers by Roth (1979) and Binmore (1980). See Binmore et. al. (1986) for a good summary of the relevant models.

⁹Non-content costs are all costs required to run the business apart from what is paid to clear copyrights.

¹⁰These two assumptions are not meant to imply that all of the costs of the two players are variable, but simply that whatever are their total costs, they can always be expressed as a fraction of their revenue.

$$\begin{aligned}
N_\sigma &= -\pi(1 + m'(\sigma))(1 - s - \sigma - m(\sigma))^{\pi-1}(\sigma(1 - \gamma))^{1-\pi} + (1 - \pi)(1 - s - \sigma - m(\sigma))^\pi(\sigma(1 - \gamma))^{-\pi}(1 - \gamma) \\
&= -\pi(1 + m'(\sigma))(1 - s - \sigma - m(\sigma))^{\pi-1}\sigma^{(1-\pi)}(1 - \gamma)^{1-\pi} + (1 - \pi)(1 - s - \sigma - m(\sigma))^\pi\sigma^{-\pi}(1 - \gamma)^{1-\pi} \\
&= (1 - \gamma)^{1-\pi}(1 - s - \sigma - m(\sigma))^\pi\sigma^{-\pi} [-\pi(1 + m'(\sigma))(1 - s - \sigma - m(\sigma))^{-1}\sigma + (1 - \pi)]
\end{aligned}$$

The second derivative, $N_{\sigma\sigma}$, is negative, so the second order condition holds and the optima occurs at σ such that $N_\sigma = 0$. Thus the optimal solution, σ^* , satisfies

$$-\pi(1 + m'(\sigma^*))(1 - s - \sigma^* - m(\sigma^*))^{-1}\sigma^* + (1 - \pi) = 0$$

That is

$$\sigma^* = \frac{(1 - \pi)(1 - s - \sigma^* - m(\sigma^*))}{\pi(1 + m'(\sigma^*))} \quad (1)$$

To obtain an precise solution we require an expression for $m(\sigma)$. In the following sections we consider two simple cases, $m(\sigma)$ equal to a constant, and $m(\sigma)$ a linear function.

3.1. $m(\sigma)$ Constant. If we let $m(\sigma) = C$, $C \in \mathbb{R}^+$, and denote the corresponding optimal solution by σ_c^* , then from (1) we obtain the following

$$\begin{aligned}
\sigma_c^* &= \frac{(1 - \pi)(1 - s - \sigma_c^* - C)}{\pi} \\
\sigma_c^*\pi &= (1 - \pi)(1 - s - C) - (1 - \pi)\sigma_c^* \\
\sigma_c^*\pi + (1 - \pi)\sigma_c^* &= (1 - \pi)(1 - s - C) \\
\sigma_c^* &= (1 - \pi)(1 - s - C)
\end{aligned}$$

Note that as long the solution is above the disagreement point,¹¹ σ_c^* will be strictly positive.

In this case, the retained earnings of the service is a fraction of revenue equal to

$$\begin{aligned}
1 - s - \sigma_c^* - C &= (1 - s) - (1 - \pi)(1 - s - C) - C \\
&= (1 - s - C)\pi
\end{aligned}$$

In terms of comparative statics, a marginal unit increase in C has the following effects:

- (1) It increases the payment to musical works copyright holders in a ratio one-to-one.
- (2) It decreases the bargained sound recording fee by $1 - \pi$.
- (3) It increases the total royalty payments by the distributor by π .

If, as seems to be the logical case currently, the distributor's bargaining power π is rather small, then a marginal increase in C is almost totally absorbed by a decrease in the negotiated fee for sound recording copyright holders, leaving the distributor in almost an unchanged situation.

3.2. $m(\sigma)$ Linear. If we let $m(\sigma) = D\sigma$, $D \in \mathbb{R}^+$, and denote the optimal solution by σ_d^* , then from (1) we obtain

¹¹The disagreement point involves no deal between the distributor and the label, and thus no streaming service can operate. Clearly, this will generate no revenue at all, and all parties receive \$0 from the business. There may, however, exist alternative outside options that do generate some revenue for the copyright holders, but we know from the Outside Options Principle that those opportunities are not a disagreement point. See, for example, Binmore et. a. (1986) for a discussion on the Outside Options Principle.

$$\begin{aligned}
\sigma_d^* &= \frac{(1-\pi)(1-s-\sigma_d^*-D\sigma_d^*)}{\pi(1+D)} \\
\sigma_d^*\pi(1+D) &= (1-\pi)(1-s-\sigma_d^*(1+D)) \\
\sigma_d^*\pi(1+D) + (1-\pi)\sigma_d^*(1+D) &= (1-\pi)(1-s) \\
\sigma_d^*(1+D) &= (1-\pi)(1-s) \\
\sigma_d^* &= \frac{(1-\pi)(1-s)}{(1+D)}
\end{aligned}$$

Once again this is also strictly positive.

Under a linear fee for the musical works copyright license, the service retains a fraction of revenue equal to

$$\begin{aligned}
1-s-\sigma_d^*(1+D) &= (1-s) - (1-\pi)(1-s) \\
&= (1-s)\pi
\end{aligned}$$

Notice that, interestingly, this is independent of D .

The payment to musical works under the linear remuneration function is

$$D\sigma_d^* = \frac{D(1-\pi)(1-s)}{(1+D)}$$

The comparative statics this time are the following. A marginal unit increase in D will:

- (1) Increase the payment to musical works by $\frac{(1-\pi)(1-s)}{(1+D)^2} > 0$.
- (2) Decrease the negotiated payment to sound recording copyright holders by $-\frac{(1-\pi)(1-s)}{(1+D)^2} < 0$.
- (3) Leave the total royalty burden faced by the distributor unchanged.

In this case, then, any increase in D that is decided by the CRB is irrelevant for the distributor, and will benefit musical works copyright holders.

The above analysis of the two options for remunerating musical works gives us the following:

Theorem 1. *Under a musical works rate that is a constant fraction C of distributor revenue, the distributor will retain less revenue than under a musical works rate that is a linear function of the negotiated sound recording rate, $D\sigma$, regardless of what the particular values of C and D are.*

Given the choice, the music distribution service strictly prefers a musical works rate that is a linear function of the negotiated sound recording rate.¹² But what about the two copyright holders? Which structure do they each prefer? To consider that question, all we need to look at is the fraction of service revenue that each of them retains under each of the two musical works rate structures. The label's preference depends

¹²Curiously, in the to-and-fro of expert witness documents that the CRB considered when considering the rate structure during the 2018 deliberations, including the ensuing remand, the services have consistently opposed the setting of a rate that is a given fraction of the negotiated sound-recording rate.

upon which of σ_c^* and σ_d^* is the largest. That is;

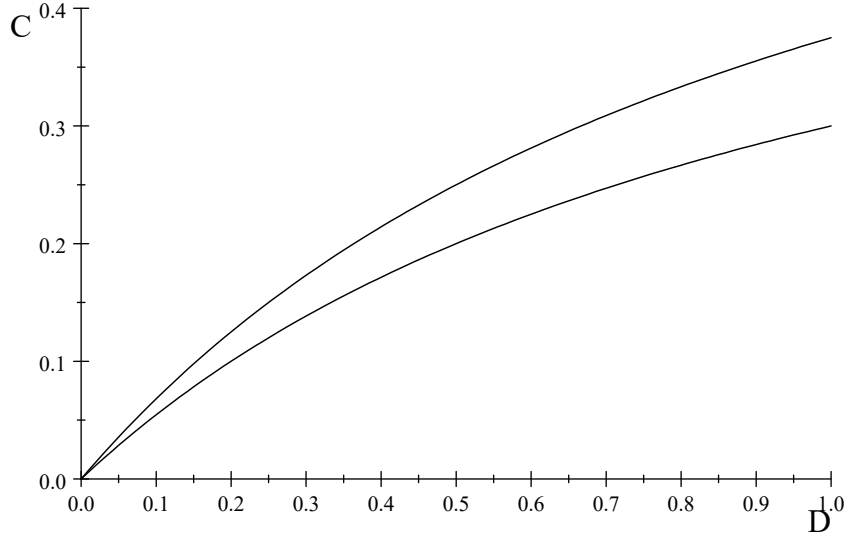
$$\begin{aligned}
(1 - \pi)(1 - s - C) &\stackrel{\geq}{\leq} \frac{(1 - \pi)(1 - s)}{(1 + D)} \\
(1 - s - C) &\stackrel{\geq}{\leq} \frac{(1 - s)}{(1 + D)} \\
(1 - s - C)(1 + D) &\stackrel{\geq}{\leq} 1 - s \\
(1 - s)(1 + D) - (1 - s) &\stackrel{\geq}{\leq} C(1 + D) \\
D(1 - s) &\stackrel{\geq}{\leq} C(1 + D) \\
\left(\frac{D}{1 + D}\right)(1 - s) &\stackrel{\geq}{\leq} C \\
C &\stackrel{\geq}{\leq} \left(\frac{D}{1 + D}\right)(1 - s)
\end{aligned}$$

On the other hand, the musical works copyright holder's (songwriters) preference depends on

$$\begin{aligned}
C &\stackrel{\geq}{\leq} \frac{D(1 - \pi)(1 - s)}{(1 + D)} \\
C &\stackrel{\geq}{\leq} \left(\frac{D}{1 + D}\right)(1 - \pi)(1 - s)
\end{aligned}$$

Theorem 2. *If $C > \left(\frac{D}{1+D}\right)(1 - s)$, then the label prefers D to C and songwriters prefer C to D . If $C < \left(\frac{D}{1+D}\right)(1 - \pi)(1 - s)$ then songwriters prefer D to C and the label prefers C to D . If $\left(\frac{D}{1+D}\right)(1 - s) > C > \left(\frac{D}{1+D}\right)(1 - \pi)(1 - s)$ then both the label and songwriters prefer C to D .*

Thus, there is no configuration of C and D such that both of the copyright holders, simultaneously, prefer D over C . So it is impossible to give all three participants their preferred musical works rate structure. However, there does exist a range of values of C such that both copyright holders simultaneously prefer C over D , which is the opposite preference to the distributor. Interestingly, there is also a range of values of D and C for which the preferences of the distributor and the musical works copyright holders are aligned (both prefer D). The graph below shows the two curves $C = \left(\frac{D}{1+D}\right)(1 - s)$ (uppermost curve) and $C = \left(\frac{D}{1+D}\right)(1 - \pi)(1 - s)$ (lowermost curve), when $\pi = 0.2$ and $s = 0.25$. For any given x -axis value of D , the preferences of the musical works copyright holder and the music distribution service are aligned (both prefer D) when C is below the lower curve, the preferences of the two copyright holders are aligned (both prefer C) if C is between the two curves, and the preferences of the distributor and the label are aligned (both prefer D) if C is above the higher curve.

Figure 1: Preferences of participants for C and D 

3.3. A Special But Realistic Case. However, not all songwriter remuneration contracts will be everywhere derivable. Consider, for example, the following contract, which was in fact the chosen structure of the CRB in both the 2022 remand of the 2018 proceedings, and in the new rates set down for the period 2023-27:¹³

$$m(\sigma) = \max \{C, D\sigma\} \quad (2)$$

where C and D are constants. In this case the Nash bargaining problem is not derivable at the point $\sigma = C/D$. Thus, the problem to analyse is

$$\max_{\sigma} (1 - s - \sigma - m(\sigma))^{\pi} (\sigma(1 - \gamma))^{1-\pi} \quad (3)$$

where $m(\sigma)$ is as defined in (2). Since the problem is continuous everywhere, including at the non-derivable point, the solution to the general optimization problem (3) must be the maximum of the solution to one of the following related problems

$$\begin{aligned} \max_{\sigma} (1 - s - \sigma - C)^{\pi} (\sigma(1 - \gamma))^{1-\pi} \\ \text{s.t. } \sigma \leq C/D \end{aligned} \quad (4)$$

$$\begin{aligned} \max_{\sigma} (1 - s - \sigma - D\sigma)^{\pi} (\sigma(1 - \gamma))^{1-\pi} \\ \text{s.t. } \sigma \geq C/D \end{aligned} \quad (5)$$

Given the results established earlier, both of these problems are well behaved and can be solved using standard methods. To that end, define the following:

- (1) $\tilde{\sigma}_c$ is the unconstrained maximum of $N^c(\sigma) = (1 - s - \sigma - C)^{\pi} (\sigma(1 - \gamma))^{1-\pi}$.
- (2) $\tilde{\sigma}_d$ is the unconstrained maximum of $N^d(\sigma) = (1 - s - \sigma - D\sigma)^{\pi} (\sigma(1 - \gamma))^{1-\pi}$.

¹³See footnote 5 above for the most recent CRB determinations.

- (3) σ_c^* is the solution to the constrained problem (4).
- (4) σ_d^* is the solution to the constrained problem (5).
- (5) σ^* is the solution to the unconstrained problem (3).

The following result is immediately clear, but very useful for working out the general solution:

Lemma 1. $N^c(\sigma)|_{\sigma=\frac{C}{D}} = N^d(\sigma)|_{\sigma=\frac{C}{D}}$.

Beginning with (4), since the objective function is strictly concave, clearly either $\sigma_c^* = \tilde{\sigma}_c$ or $\sigma_c^* = C/D$. More concretely,

$$\sigma_c^* = \begin{cases} \tilde{\sigma}_c & \text{if } \tilde{\sigma}_c \leq \frac{C}{D} \\ \frac{C}{D} & \text{if } \tilde{\sigma}_c > \frac{C}{D} \end{cases}$$

Likewise,

$$\sigma_d^* = \begin{cases} \tilde{\sigma}_d & \text{if } \tilde{\sigma}_d > \frac{C}{D} \\ \frac{C}{D} & \text{if } \tilde{\sigma}_d \leq \frac{C}{D} \end{cases}$$

Then, we also have

$$\sigma^* = \begin{cases} \sigma_c^* & \text{if } N^c(\sigma_c^*) > N^d(\sigma_d^*) \\ \sigma_d^* & \text{if } N^d(\sigma_d^*) > N^c(\sigma_c^*) \end{cases}$$

The following result characterises the solution to (3) for an important range of parameter values:

Theorem 3. *If $\sigma_c^* = \tilde{\sigma}_c$ then $\sigma^* = \tilde{\sigma}_c$.*

Proof. If the solution to (4) is $\tilde{\sigma}_c$, then we know that $\tilde{\sigma}_c = (1 - \pi)(1 - s - C) \leq \frac{C}{D}$. Straight-forward operations on this inequality lead to it being written as

$$\frac{(1 - \pi)(1 - s)}{1 + (1 - \pi)D} \leq \frac{C}{D}$$

But since $1 + (1 - \pi)D < 1 + D$, we have

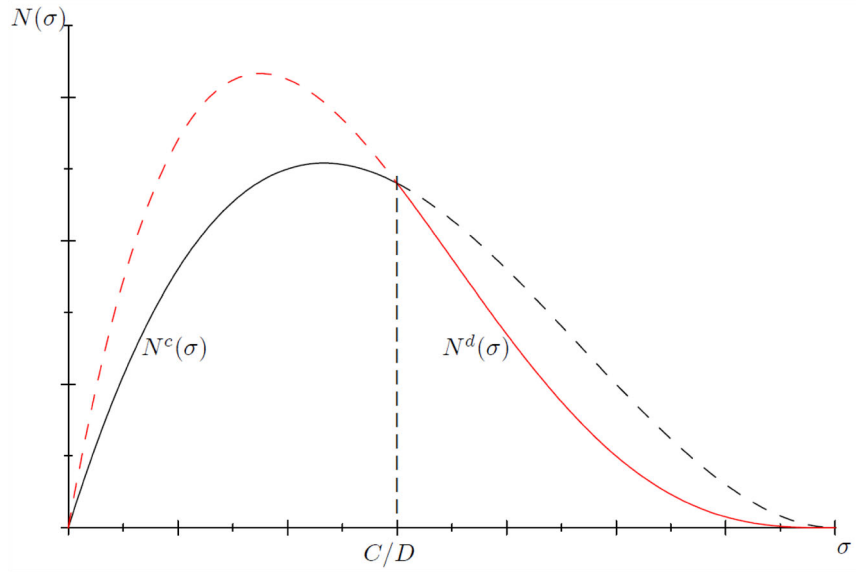
$$\tilde{\sigma}_d = \frac{(1 - \pi)(1 - s)}{1 + D} < \frac{(1 - \pi)(1 - s)}{1 + (1 - \pi)D} \leq \frac{C}{D}$$

which tells us that the solution to (5) is $\sigma_d^* = \frac{C}{D}$. And since $N^c(\sigma)$ is strictly concave, by Lemma 1 $N^c(\tilde{\sigma}_c) \geq N^c(\frac{C}{D}) = N^d(\frac{C}{D})$. Therefore, the solution to (3) is $\sigma^* = \tilde{\sigma}_c$. ■

This result tells that that any case where σ_c is a solution to its corresponding constrained optimization problem (4), σ_d will not be a valid solution to its corresponding constrained optimization problem (5). This can be easily characterised as

$$\sigma^* = \tilde{\sigma}_c \text{ if } (1 - \pi)(1 - s - C) \leq \frac{C}{D}$$

We refer to this as ‘‘Case 1’’. It is shown graphically in Figure 2.

Figure 2: A typical “Case 1” solution in which $\sigma^* = \tilde{\sigma}_c$ 

There are two other cases, corresponding to $(1 - \pi)(1 - s - C) > \frac{C}{D}$, that is, the solution to (4) is $\sigma^* = \frac{C}{D}$. The first of these, “Case 2”, is when the solution to both (4) and (5) are $\frac{C}{D}$, and when the solution to (5) is $\tilde{\sigma}_d$ (“Case 3”). It is then straightforward to see that the solution to the general problem (3) for these three cases, as defined by the parameters in question, is:

$$\sigma^* = \begin{cases} \tilde{\sigma}_c & \text{if } (1 - \pi)(1 - s - C) < \frac{C}{D} \\ \frac{C}{D} & \text{if } \frac{(1 - \pi)(1 - s)}{1 + D} \leq \frac{C}{D} \leq (1 - \pi)(1 - s - C) \\ \tilde{\sigma}_d & \text{if } \frac{C}{D} < \min \left\{ \frac{(1 - \pi)(1 - s)}{1 + D}, (1 - \pi)(1 - s - C) \right\} \end{cases}$$

Cases 2 and 3 are shown graphically in Figures 3 and 4.

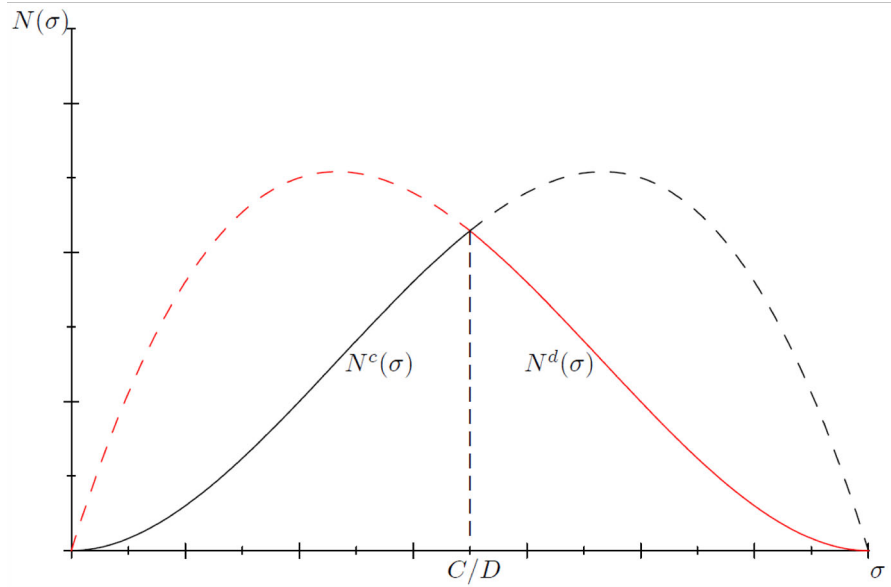
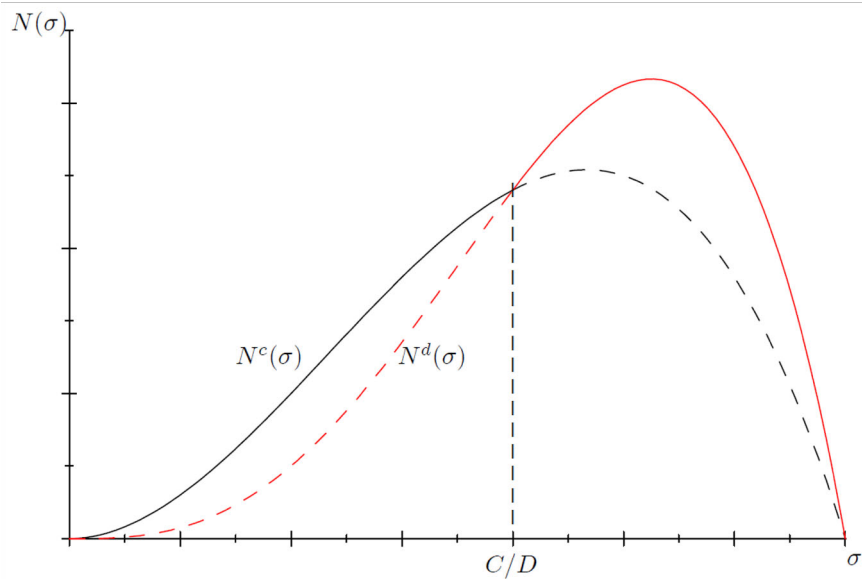
Figure 3: A typical “Case 2” solution in which $\sigma^* = \frac{C}{D}$ 

Figure 4: A typical “Case 3” solution in which $\sigma^* = \tilde{\sigma}_d$ 

4. SOME CALIBRATED NUMERICAL EXAMPLES

The solution to the general problem is determined by the values of two parameters – namely π and s – and the two policy variables that are chosen by the Copyright Royalty Board – namely C and D . In this section, we explore some numerical examples.

There are two explicit sets of values of C and D that are worth considering. First, in the final determination (issued in 2022, after the remand proceedings) of the 2018 rate-setting proceedings, the CRB decreed that both C and D would increase marginally each year over the relevant 5-year period (2018 through to 2022). Second, the rates agreed to (by settlement between the parties) and ratified by the CRB for the period 2023 to 2027, are the following (including the value of $\frac{C}{D}$, which was not actually reported by the CRB):¹⁴

Table 1: The values of C and D as decided by the CRB

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
C	0.114	0.123	0.133	0.142	0.151	0.151	0.152	0.1525	0.153	0.1535
D	0.22	0.231	0.241	0.252	0.262	0.262	0.262	0.262	0.262	0.262
$\frac{C}{D}$	0.518	0.532	0.552	0.563	0.576	0.576	0.58	0.582	0.584	0.586

Interestingly, then, the CRB has chosen values such that the non-derivable point in the negotiations between distributors and sound-recording copyright holders increases monotonically over time.

Second, in order to get any further on the issue, we require an estimate of the non-content costs of distributors. Perhaps the best way forward on that is to take the case of one of the principal online music distribution companies, namely Spotify. According to dittomusic.com, Spotify pays approximately 70% of its revenue to the copyright holders in the music it plays.¹⁵ Therefore, the sum of the musical works royalty payment and the sound recording royalty payment is approximately 0.7. Second, looking at the annual accounts of Spotify, in every year so far they report net operating income that is relatively small in comparison to their revenue (which is currently approximately 12 billion Euros per year), but always

¹⁴See footnote 7 above for these two final determinations.

¹⁵See <https://dittomusic.com/en/blog/how-much-does-spotify-pay-per-stream/>

negative.¹⁶ Therefore, it must be the case that all of the revenue that Spotify doesn't pay out to copyright holders, is used up in non-content costs. That tells us that s is approximately equal to 30 percent of revenue. In our first examples, we shall take $s = 0.3$.

With that in hand, the negotiated solution would be at $\tilde{\sigma}_c$ for any pair (C, D) such that

$$1 - \pi < \frac{C}{D(0.7 - C)}$$

which is

$$1 - \frac{C}{D(0.7 - C)} < \pi$$

The values of $1 - \frac{C}{D(0.7 - C)}$ for the CRB mandated determinations between 2018 and 2027 are the following:

Table 2: Values of $1 - \frac{C}{D(1-s-C)}$ with $s = 0.3$

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
$1 - \frac{C}{D(0.7-C)}$	0.116	0.077	0.027	0.010	-0.050	-0.050	-0.059	-0.063	-0.068	-0.072

Interestingly, then, from 2022 onwards, the CRB has designated values of (C, D) such that $1 - \frac{C}{D(0.7-C)} < 0$, and in which case, since it is very safe to assume that $\pi > 0$ (the distributors have some positive degree of bargaining power) the solution to the general bargaining problem will be at $\tilde{\sigma}_c = (1 - \pi)(1 - s - C)$. The result will be that the copyright royalty rate paid to musical works copyright holders will be a fraction C of the revenue of the music distribution business.

Of course, that result depends critically on the assumption of $s = 0.3$. If in fact, s is some other number, then our calculations will change somewhat. For example, if we use instead $s = 0.25$, we get the following results:

Table 3: Values of $1 - \frac{C}{D(1-s-C)}$ with $s = 0.25$

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
$1 - \frac{C}{D(0.75-C)}$	0.185	0.151	0.106	0.073	0.038	0.038	0.030	0.026	0.022	0.018

So, under the assumption that $s = 0.25$, between 2018 and 2027 we should likely expect that a variety of different outcomes, on either side of the point $\sigma = \frac{C}{D}$ could have resulted, although, if we assume that π has remained relatively constant over the entire 10-year period, then perhaps the negotiated outcome may have shifted from above $\frac{C}{D}$ in the early years, to equal to $\frac{C}{D}$, and finally to below $\frac{C}{D}$. If, for example, we posit that $\pi = 0.07$, then

Table 4: Solution to the general problem, assuming $s = 0.25$ and $\pi = 0.07$

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
$\frac{C}{D}$	0.518	0.532	0.552	0.563	0.576	0.576	0.58	0.582	0.584	0.586
$(1 - \pi)(1 - s - C)$	0.591	0.583	0.574	0.565	0.557	0.557	0.556	0.556	0.555	0.555
$\frac{(1-\pi)(1-s)}{1+D}$	0.572	0.567	0.562	0.557	0.553	0.553	0.553	0.553	0.553	0.553
Solution	$\tilde{\sigma}_d$	$\tilde{\sigma}_d$	$\tilde{\sigma}_d$	$\frac{C}{D}$	$\tilde{\sigma}_c$	$\tilde{\sigma}_c$	$\tilde{\sigma}_c$	$\tilde{\sigma}_c$	$\tilde{\sigma}_c$	$\tilde{\sigma}_c$

¹⁶See <https://www.statista.com/statistics/244990/spotifys-revenue-and-net-income/>

5. CONCLUSION

We consider a simple extension of the generalized Nash bargaining model to accommodate some cases that arise in the American music industry, specifically, interactive music streaming. In this industry, the share of revenues received by songwriters as remuneration for the use of their copyright in musical works is set by the Copyright Royalty Board (CRB) while the copyright holders in the sound recordings (e.g. recording studios and record labels) are free to bargain with music distributors (e.g. Spotify) for their remuneration. We explore three simple models for songwriter remuneration; a fixed rate, a rate linearly proportional to the share earned by record labels, and the maximum of the two previous models. We show that different parties prefer different models and that none of these models represent a Pareto improvement over the others. Furthermore, we find the solution to the main model, which in fact conforms with the structure that the CRB has adopted in its most recent two determinations. Using the actual data corresponding to these determinations, we calculate the Nash Bargaining solution, and we show that it appears that over the next several years, the solution will ignore the option of a rate that is linearly proportional to the bargained sound recording payment.

REFERENCES

- Binmore, K. (1980), "Nash Bargaining Theory II", ICERD, London School of Economics, D.P. 80/14.
- Binmore, K., A. Rubinstein and A. Wolinsky (1986), "The Nash Bargaining Solution in Economic Modelling", *RAND Journal of Economics*, 17(2); 176-88.
- Landau, M.B. (2000), "Publication, Musical Compositions, and the Copyright Act of 1909: Still Crazy After All These Years", *Vanderbilt Journal of Entertainment and Technology Law*, 2(1), Article 3.
- Musical Works Modernization Act 2018, available at www.govinfo.gov/content/pkg/PLAW-115publ264/pdf/PLAW-115publ264.pdf
- Nash, J. (1950), "The Bargaining Problem", *Econometrica*, 18(2); 155-62.
- Roth, A. (1979), *Axiomatic Models of Bargaining*, Berlin, Springer-Verlag.
- The Copyright Act 1909, available at <https://www.copyright.gov/history/1909act.pdf>