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COPYRIGHT LICENSING UNDER ASYMMETRIC INFORMATION

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Abstract. In this paper we aim to contribute to the discussion on the role of royalties in copyright agreements by concentrating on the incentives that they provide to the creator and the intermediary when the success of the work depends on their involvement with the commercialization process. We also consider the effect of this moral hazard on the matching among creators and intermediaries and their gains.

1. Introduction

Artists (authors, composers, painters) typically need an intermediary to bring their work to the market. In the words of Caves (2003): "The inspirations of talented artists reach consumers' hands (eyes, ears) only with the aid of other inputs—*humdrum inputs*—that respond to ordinary economic incentives." *Copyright contracts* allow the intermediaries to market works in exchange for a payment to the artists. Take as an example the case of an author and a publisher. The copyright agreement grants the publisher permission to copy, display, and distribute the work and act to safeguard the author's intellectual property. In exchange, the author (e.g., the writer, the photographer, the comic creator) will receive a remuneration as compensation for his creation.

The economic role of copyright regulation is to provide incentives to create and disseminate the expression of ideas. At the same time, copyright contracts, just like any contract, also establish the transfer among the involved parties, they deal with the sharing of the risk among the participants and provide incentives to reveal information or to invest in the success of the relationship. In this paper, we concentrate on this last aspect of a copyright agreement.

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Incentives are important to realize the market value of the good that is being commercialized. Consider the agreement between an author who has written a book and a producer who is contemplating buying a license in order to make a film based on this book.[1] The collaboration of the author with the script for the movie may facilitate having an attractive plot.[2] In the same manner, the producer's decisions concerning the actors to be hired to perform in the movie will affect the interest of the public.

At the time the author of the creation and the publisher sign the copyright agreement, in other words ex-ante, there is uncertainty about the value of the good for the consumers because the public preferences for this good are unknown and, more importantly for our interest in this paper, because they are not yet formed. In particular, the appreciation of the public for the good will depend on the author's and the publisher's involvement in its promotion. This involvement generates a moral hazard situation.[3]

To provide incentives to invest in the success of the commercialization of the work, the parties tend to write a success-contingent copyright contract, instead of a fixed-fee contract. A contingent contract gives the author (artist) a share of the final sales (or sometimes profits), that is, it includes a royalty.[4] The use of royalties in the copyright agreements is common in the case of stars, although is much less frequent when the author is not a well-known artist (Chisholm, 1993). However, even in the case of unknown artists, copyright contracts often include a clause stating that the author will receive a percentage of the revenue of the sales if the work is a blockbuster.[5] One argument for the inclusion of royalties may be related to the degree of risk aversion of these different artists. However, if we accept the idea that

[1]In this paper we concentrate on examples from the cultural and entertainment industry and mostly on the publication of a book, for illustration purposes. The intuitions and conclusions are general and can be applied to other cases.
[2]Adapting a novel may include changing the characters and even eliminating some central ones. The story has to be simplified, sometimes the action or the romantic dimension is put forward, and the ending is altered. When the author is involved, these changes may be difficult to make. It is said that Pamela Lyndon Travers, the author of Mary Poppins, made this process very difficult because she greatly disapproved of the Disney adaptation, in particular the dilution of some elements of Mary Poppins' character, the inclusion of songs in the movie, and the use of animation.
[3]For a general view of incentive contracts under asymmetric information, see Macho-Stadler and Pérez-Castrillo (1997).
[4]See, e.g., Macho-Stadler, Martínez-Giralt and Pérez-Castrillo (1996) and Towse (1999).
[5]For example, the German copyright law includes the "bestseller paragraph," which stipulates that the author has a legally enforceable right to a bonus in case ex-post the work turns out a big hit (see Engel and Kurschilgen, 2011).

artists tend to be more risk averse than their intermediary, risk aversion would lead to very low royalties, and they would be particularly lower for the less wealthy artists and in case of success.[6] Another reason to include royalties into the agreement, the one we analyze in this paper, is to provide inducements to the artist to be committed to the success of his work.

Taking an exogenously given pair of participants in a copyright contract, the literature also discusses the participants' bargaining power as an important element influencing the terms of the copyright licensing agreement (e.g., Muthoo, 2006). In this paper, we consider market competition to be another important element in the determination of the parties' outside opportunities in a negotiation and their bargaining power. A useful tool to introduce general equilibrium reasoning in the incentive contracts is to use matching models, particularly those derived from the so-called assignment games. These games allow the joint analysis of the identification of the partners that enter into a relationship, the level of utility (profits) that each will obtain, and the optimal contract for each partnership. In any partnership, each party has a reservation value, but mutually acceptable deals depend, in equilibrium, on other potential deals. To understand the equilibrium mechanisms at work, we present in the second part of this paper a one-to-one two-sided matching market model with two heterogeneous publishers and two heterogeneous authors. We discuss the type of matching that emerges at equilibrium and how equilibrium conditions and the moral hazard problem affect the level of utility of authors and publishers.[7]

The remainder of the paper is organized as follows. In Section 2 we introduce and discuss the model. In Section 3 we analyze the optimal contracts for an isolated given partnership under symmetric information and also when a double moral hazard problem exists. In Section 4 we introduce the matching model and study the equilibrium matching and payoffs. Finally, in

[6]See Watt (2013) for a discussion on royalties and risk sharing.
[7]This approach is similar to the recent literature analyzing different problems from the perspective of the two-sided market matching models with endogenous contracts that follow the optimal assignment literature proposed by Becker (1973). See, for example, Alonso-Paulí and Pérez-Castrillo (2012).

Section 5 we briefly discuss several relevant aspects related to incentives in copyright contracts that we have not considered in our model.

2. Model

A copyright contract is an agreement between the original creator (the author)[8] and an intermediary (the publisher)[9] that transfers the right to use the creation or to sell the good produced. We refer to these two participants as A and P (related to author or agent, and publisher or principal). We follow the traditional convention of the principal-agent literature and refer to A as "he" and to P as "she".

Suppose a publisher, P, and an author, A, who establish a relationship by signing a copyright licensing contract. We assume for simplicity that both parties are risk neutral. We also assume that the author has a lower knowledge of the market than the publisher, who has access to the market and can distribute the good at a lower cost.

The selling of the work x can take two values, $x \in \{H, L\}$, with $H > L$, that we interpret as a high or low demand or revenue for the pictorial, literary, graphic or sculptural work. This represents the fact that the artist works in a "winner-take-all" market. Stylized facts show that very few movies, books, and songs generate huge sales (represented by H), whereas the great bulk of these creations barely manage to recover production costs (shown as L).[10]

Whether the art work is a useful article, has a high value for consumers, or is a major success in the market in general depends on many features which are difficult to anticipate. The creative industry is by nature a risky activity. If the work reaches consumers, it can have

[8]The original creator may not be the owner of the property rights. In addition to the creator of the copyrighted work, the owner of a copyright can also be the creator's employer (in the case of a work-for-hire) or the creator's heirs (if the creator has died). Who the owner of the property right is may be important for incentives.

[9]The intermediary has the right to "use" the author's work. He can also have the right to "sell" or "distribute" the creator's work.

[10]For example, Kretschmer and Hardwick (2007) show that for writers in the UK the distribution of income is highly unequal. In 2004-2005, the top 10% of professional writers in the UK earned about 60% of total income (they earn at least £68,200 per year), while the bottom 50% earned about 8% of total income. This implies a Gini coefficient of 0.63, while the national Gini coefficient for all employees in the UK is 0.33.

a huge success but in many cases the publisher sells very few copies of the author's work. Among the factors that influence the financial and literary success of a work, some of them are determined after it has been made available and the copyright contract has been signed, and they depend on the decisions of the two parties. In our model, we consider the importance of the participants' decision by assuming that the probability of outcome $x = H$ depends on the involvement of both parties.

Several decisions can increase the sale of the work. The publisher can encourage good results by investing in marketing and promoting strategies. We denote these actions by a, which can refer, for example, to the advertizing strategy, often directed at salesmen, distributors and retailers, that allows cornering the market.[11] In the case of literature, the investment a can also refer to the publisher including the book in a prestigious series or giving it front page coverage in the catalog to increase its visibility. Other examples of the publisher's activities that increase the likelihood of a good result are hiring an artist to produce an aesthetic, elegant, and eye-catching cover, or having a prestigious critic write the blurb (the description on or inside the book jacket). Publishers can also influence readers to order or buy a book by allowing them to read a chapter online. In the case of a movie, the studio can increase the perception of quality in the eyes of consumers by assuming more cost such as paying more elaborate special effects, or crowds of extras. Moreover, consumers expectation's over a film's content and quality can be influenced by the production of eye-catching trailers.[12]

The author also has a say on the outcome. He can spend his own time and money to increase the visibility of his work. We refer to these activities as effort and denote them by e. For example, the decision e can refer to the author's involvement in setting up signings, arranging for book tours, speaking at events, attending conventions and conferences, as well

[11]This includes the publisher pushing the book at conventions and sales conferences, sending publisher's newsletters to distributors, etc. It also includes reviews in newspapers and magazines under a "recommended" or "a new book of" tag.

[12]For an overview of the literature on consumer expectations, applied to the context of the motion picture industry, see Finsterwalder, Kuppelwieser, and de Villiers (2012). They highlight the fact that for a film to be successful at attracting as large an audience as possible, the use of an effective promotional campaign is crucial. For example, they discuss how a good trailer plays a significant role in its success.

as arranging for newspaper and radio interviews or contacting reviewers. This decision can also refer to the effort of using the web to access fans or being present in the appropriate genre-specific web site. The author may give concerts, for example, that help increase his visibility, the public goodwill and interest, and also help him to connect with their fans to increase the popularity of his work. He may also appear in the tabloids or expose the details of his private life in the media to gain their attention. Finally, the author's effort may refer to including changes in the original manuscript, for example, to make it conform with popular trends.[13]

The ability of the participants also affect the probability of a good outcome. Let us denote by θ_P the ability of P and by θ_A the ability of A. For example, θ_A includes the quality of the author's writing, whether the book has a solid story, with believable characters, intriguing ideas, etc. The fame of the writer following his previous publications also influences what we call his ability. In contrast, θ_P includes the ability, the network, and the knowledge of the market that the publisher has, which would facilitate getting the work to market in a timely manner.

Following the previous discussion, we assume that the probability and the value of success, that is, the probability and value of obtaining the outcome $x = H$ as a function of the abilities and investments $(\theta_P, \theta_A, a, e)$ has the form

$$s = \gamma\theta_A\theta_P + a\theta_P + e\theta_A,$$

where $\gamma \geq 0$ represents the complementarities among the participants' characteristics.[14] These complementarities reflect, for example, the fact that a better publisher (a better actor) will succeed in obtaining more from a good author (a better script) and vice-versa.

[13]See Caves (2003) for a discussion of the characteristic of creative industries and the agreements between creators and distributors.

[14]When interpreting s as a probability, we can introduce assumptions on the parameters to guarantee $s \in [0, 1]$. Alternatively, we can interpret s as a production function that determines the value in the market in case of success. As a production function, the same expression has been used for other joint production problems. See, for example, Ghatak and Karaivanov (2014) for an analysis of contracts and matching in agricultural production.

The copyright agreement includes a payment or transfer from P to A. This payment can be fixed or can depend on success. We assume that A receives from P a transfer $t = (t_L, t_H)$ that has the form

$$\begin{aligned} t_L &= F && \text{if } x = L \\ t_H &= F + R && \text{if } x = H \end{aligned}$$

where we interpret F as a fixed fee and, if we define $r \equiv \frac{R}{(H-L)}$, then r is a royalty.

Finally, we introduce the objective function of the participants. The publisher's benefit function is

$$B = x - t - \frac{1}{2}a^2,$$

where the last term represents the cost of action a. The author's utility takes the form

$$U = t - \frac{1}{2}e^2,$$

where the last term is the cost of effort e.[15] To summarize the bargaining power of the author in the definition of the contract, we assume that the author has a reservation utility equal to $\underline{U}$, which can represent the possibility of having another publisher for his book, or publishing the book himself, or not taking the creation to the market. We come back to this assumption later in Section 4.

3. Optimal copyright contract

3.1. **Symmetric information.** We first characterize the optimal contract under symmetric information, which is defined as the first-best, that is, the situation where the parties can agree ex-ante not only on the payoffs but also on their involvement in the relationship. Formally, this means that the vector of decisions and payments (a, e, F, R) is the solution to the following

[15] It is immediate to extend the analysis to any cost function that is convex on a or e, possibly different. The choice of quadratic functions with parameters $\frac{1}{2}$ is done for simplicity because first-order conditions are simple in this case.

maximization problem:

$$Max\left\{L-F+\left(\gamma\theta_A\theta_P+a\theta_P+e\theta_A\right)\left(H-L-R\right)-\frac{1}{2}a^2\right\}$$
$$\text{s.t.}\quad F+\left(\gamma\theta_A\theta_P+a\theta_P+e\theta_A\right)R-\frac{1}{2}e^2\geq\underline{U}.$$

The constraint of this program is the author's participation constraint. He will sign the copyright agreement only if this agreement allows him to obtain at least his reservation utility. Since P would like to transfer to A the minimum possible amount, the participation constraint binds in the solution of the program. This implies that

$$F=\underline{U}-\left(\gamma\theta_A\theta_P+a\theta_P+e\theta_A\right)R+\frac{1}{2}e^2,$$

which allows us to find the fixed fee once the other elements of the contract are determined. Now, the problem can be written as

$$Max\left\{L-\underline{U}+\left(\gamma\theta_A\theta_P+a\theta_P+e\theta_A\right)R-\frac{1}{2}e^2+\left(\gamma\theta_A\theta_P+a\theta_P+e\theta_A\right)\left(H-L-R\right)-\frac{1}{2}a^2\right\}.$$

The first-order conditions of this program with respect to a, e, and R are[16]

$$\begin{aligned}\frac{\partial}{\partial a} &= \theta_P R+\theta_P\left(H-L-R\right)-a=0\Leftrightarrow a^*=\theta_P\left(H-L\right)\\ \frac{\partial}{\partial e} &= \theta_A R+\theta_A\left(H-L-R\right)-e=0\Leftrightarrow e^*=\theta_A\left(H-L\right)\\ \frac{\partial}{\partial R} &= 0.\end{aligned}$$

Given the optimal efforts a^* and e^*, the probability of success in the first-best is

$$s^*=\gamma\theta_A\theta_P+\left(\theta_P^2+\theta_A^2\right)\left(H-L\right).$$

Moreover, the first-order conditions imply the intuitive property that the size of R, or the per-unit royalty r, is not relevant because, when agents are risk neutral and the decisions are contractible, the royalty is just a way to transfer money between two risk-neutral agents. This

[16]We do not include the discussion of the second-order conditions of this maximization program or the following one. They are satisfied because our functions are strictly concave.

transfer can be made through either F or R. For example, an optimal contract is

$$R^* = 0 \text{ and } F^* = \underline{U} + \frac{1}{2}\theta_A^2 (H - L)^2 .$$

These terms imply that the transfer to the author is larger the better he is, the bigger the success of his work in the market can be, and the higher his reservation utility (bargaining power) is.

3.2. **Double moral hazard.** Now let us make the more sensible assumption that the participants' decisions to promote the success of the work in the market cannot be fully controlled by the copyright agreement.[17] That is, at the time where efforts must be made, the publisher chooses the action a that maximizes her utility whereas the author decides the e that maximizes his utility. This induces a double moral hazard problem. Therefore, given a contract (F, R), the optimal action for the publisher is $a = \theta_P (H - L - R)$ and the optimal effort for the author is $e = \theta_A R$.[18]

[17]We acknowledge that some of the decisions made by the participants may be contractible. For example, the contract can specify the number of concerts of a singer or the number of TV ads to be paid by the record company. However, the level of effort, care, informal interviews, etc., are not contractible. In this section we concentrate on the impact of the non-contractible decisions on the terms of the contract.
Also, the parties may be motivated by other incentives not included into the copyright agreement (fame, and so forth). This is still coherent with our analysis as long as there is no perfect alignment between the interest of one participant and the success of the commercialization of the work.

[18]The optimal decision a of the publisher is the one that maximizes her profit,

$$L - F + (\gamma\theta_A\theta_P + a\theta_P + e\theta_A)(H - L - R) - \frac{1}{2}a^2.$$

The first-order condiction of this problem is

$$\theta_P (H - L - R) - a = 0,$$

which defines the incentive compatibility constraint for the publisher: $a = \theta_P (H - L - R)$. Similarly, the author maximizes the function

$$F + (\gamma\theta_A\theta_P + a\theta_P + e\theta_A) R - \frac{1}{2}e^2,$$

whose first-order condition leads to $e = \theta_A R$.

Under the double moral hazard problem, the program that determines the optimal copyright agreement is the solution to

$$Max\left\{L-F+\left(\gamma\theta_A\theta_P+a\theta_P+e\theta_A\right)\left(H-L-R\right)-\frac{1}{2}a^2\right\}$$
$$\text{s.t.}\quad F+\left(\gamma\theta_A\theta_P+a\theta_P+e\theta_A\right)R-\frac{1}{2}e^2\geq\underline{U}$$
$$a=\theta_P\left(H-L-R\right)$$
$$e=\theta_A R$$

where the first constraint is the author's participation constraint (it has the same interpretation as before) and the last two are the incentive compatibility constraints for the publisher and the author stating that their decisions are not determined by the agreement but each participant will decide the involvement that is optimal for her or him. As in the previous case, the author's participation constraint determines the size of the fixed fee as a function of the other variables and, substituting the values of a and e, it can be written as

$$F=\underline{U}-\gamma\theta_A\theta_P R-\theta_P^2\left(H-L-R\right)R-\frac{1}{2}\theta_A^2R^2$$

where, again, the larger $\underline{U}$ is (the more alternatives he has for commercializing his creation) the larger the fixed fee and/or the royalty have to be. Moreover, the larger the royalty, the lower the fixed payment will be.

Substituting the constraints, we rewrite the program as

$$Max\left\{L-\underline{U}+\left(\theta_P^2+\theta_A^2\right)\left(H-L-R\right)R+\gamma\theta_A\theta_P\left(H-L\right)+\frac{1}{2}\theta_A^2R^2+\frac{1}{2}\theta_P^2\left(H-L-R\right)^2\right\}.$$

The first-order condition of this program is

$$\frac{\partial}{\partial R}=\left(\theta_P^2+\theta_A^2\right)\left(H-L-R\right)-\left(\theta_P^2+\theta_A^2\right)R+\theta_A^2R-\theta_P^2\left(H-L-R\right)=0,$$

that is, the optimal royalty R^0 is

$$R^0=\frac{\theta_A^2}{\theta_P^2+\theta_A^2}\left(H-L\right).$$

Therefore, the per-unit royalty is

$$r^0 = \frac{\theta_A^2}{\theta_P^2 + \theta_A^2},$$

which is decreasing in the publisher's ability θ_P and increasing in the author's ability θ_A. This result is very intuitive: the larger the productivity of the author (the higher the parameter θ_A), the more important his involvement for the success of the commercialization is and the higher the optimal royalty needs to be to induce him to become more involved. There are several examples where the impact of the author in the success of the work can be crucial. For example, the nature of a book may make it necessary for the author to appear on TV shows to publicize the book, or to appear in the tabloids to appeal to this type of audience. Similarly, for some musicians it is very important that they give concerts so as to promote their CDs and through the concerts directly attract consumers. Also, the free publicity on the radio and TV that often accompanies the concerts is priceless. In those cases, a large enough royalty gives the author the right incentives to perform these activities and put effort into them. However, the larger the royalties, the less incentive the publisher has to develop promotion activities herself. Therefore, the higher the importance of the publisher in the success of the work (that is, the larger the parameter θ_P), the lower the royalty.

The optimal royalty solves the trade-off between giving incentives to the author and to the publisher. This is the reason why the optimal royalty depends not on the absolute value of the abilities θ_A and θ_P, but on the relative productivity. In fact, it can be rewritten as

$$r^0 = \frac{1}{1 + \frac{\theta_P^2}{\theta_A^2}}.$$

Therefore, the optimal royalty is large when the relative productivity of the author (the ratio $\frac{\theta_A^2}{\theta_P^2}$) is large.

Using R^0, we compute the efforts and the probability of success under double moral hazard:

$$a^0 = \frac{\theta_P^3}{\theta_P^2 + \theta_A^2}(H - L),$$

$$e^0 = \frac{\theta_A^3}{\theta_P^2 + \theta_A^2}(H - L),$$

$$s^0 = \gamma\theta_A\theta_P + \frac{\theta_P^4 + \theta_A^4}{\theta_P^2 + \theta_A^2}(H - L).$$

It is easy to verify that a participant's effort is increasing in her/his ability and decreasing in the other participant's ability. Consider the case of the author (the argument for the publisher is identical). The author's effort increases in his ability because of two effects, which go in the same direction. First, there is a direct effect: the higher his ability, the more he affects the probability of success for a given level of effort and, consequently, the greater are the incentives to work hard. Second, the optimal contractual incentives (the royalties, in the case of the author) also increase with the ability. Therefore, there is an indirect effect (through the contract) that prompts the author to exert more effort as his ability increases. The indirect effect also explains that his effort decreases with the publisher's ability: the royalties are lower when the ability of the publisher is higher, therefore the author's effort will also be lower.

As expected, under double moral hazard the contract leads both participants to exert lower efforts than in the first-best, and consequently, the probability of success is also lower. Simple calculations show that

$$a^* - a^0 = \frac{\theta_P\theta_A^2}{\theta_P^2 + \theta_A^2}(H - L),$$

$$e^* - e^0 = \frac{\theta_A\theta_P^2}{\theta_P^2 + \theta_A^2}(H - L),$$

$$s^* - s^0 = \frac{2\theta_P^2\theta_A^2}{\theta_P^2 + \theta_A^2}(H - L).$$

Therefore, the decrease in the probability of success between the two scenarios is higher when the abilities θ_P and θ_A and the prize $(H - L)$ are higher. Finally, it can also be seen that the

distortion on the effort with respect to the first-best is higher for the less able participant:

$$a^* - a^0 > e^* - e^0 \Leftrightarrow \theta_P < \theta_A.$$

4. Authors-Publishers Market

In the previous section, we analyzed the optimal contract for a partnership between a publisher and an author considered in isolation. However, in the market, there are typically several publishers looking for authors and several authors looking for publishers. Moreover, neither publishers nor authors are homogeneous; in particular, their ability is different. Any publisher would prefer to sign a contract with a well-known, popular, and high-quality author than with an author with less appealing characteristics, provided that she can secure the services of the author under similar conditions. Also, any author would prefer to sign a particular deal with a publisher of high reputation, with a large network and customer base rather than with a small publisher.

Considering a market instead of isolated relationships allows us to address at least two new questions. The first is the identity of the partners that actually sign the agreements. We can discuss, in particular, whether we should expect the intuitive property that the best authors sign deals with the best publishers and whether the moral hazard problem influences this "positive assortative" characteristic of the matching between publishers and authors. The second question is the level of utility that the participants in this market obtain. In a market equilibrium, how much an author, for instance, obtains in a contract with a publisher not only depends on the two partners signing this agreement but also on how much the author and publisher can secure for themselves in potential deals with other publishers and authors active in the market. In this sense, analyzing a market provides an alternative (and also a complementary) way to bargaining theory, to discuss the rents that the participants obtain in the contracts.[19]

[19]See Muthoo (2006) for an application of bargaining theory to royalty contract negotiations.

To illustrate this theory, we consider a "market" with two heterogeneous authors, A_1 and A_2, and two heterogeneous publishers P_1 and P_2. We assume that an author or a publisher has no utility if he or she does not agree on a copyright contract, because the author lacks the ability or the contacts to bring his work to the public, and the publisher needs a work to represent. That implies that all the agents' outside opportunity are equal to zero.[20] Alternatively, an author and a publisher can sign a copyright agreement and we assume that this allows them to obtain positive profits. In the market, the matching between publishers and authors and the licensing agreements that they sign are endogenous. For simplicity, we assume that any author has one and only one creation and that, due to time and other constraints, publishers can deal only with one creation. That is, the situation considered is a "one-to-one two-sided matching market."[21]

We assume (without loss of generality) that author A_1 has characteristic $\theta_{A1} = 1$ and A_2 has higher ability, $\theta_{A2} > 1$. Similarly, publisher P_1 has characteristic $\theta_{P1} = 1$ and P_2 has ability $\theta_{P2} > 1$. We say that the matching is "positive assortative" if the best publisher matches with the best author and the publisher with lower ability matches with the author with lower ability, that is, P_2 signs with A_2 and P_1 signs with A_1 in a positive assortative matching (see Figure 1). Alternatively, in a negative assortative matching, publisher P_1 contracts with A_2 and P_2 contracts with A_1 (see Figure 2).

We look for the characteristics of the *equilibrium* (or *stable*) outcome of this market. In equilibrium, no publisher and author can be better off by quitting their current partners and signing an alternative contract among them. Equilibrium outcomes have nice properties. First, all equilibrium contracts are optimal, which means that the agreement a given author-publisher pair signs has to be such that there is no other possible agreement that is better for

[20]This outside opportunity corresponds to not having an intermediary (i.e., not doing the film or publishing the work by himself). This is part of the reservation utility in a pre-determined principal-agent model. However, the matching model allows to endogenize the agent's reservation utility that is determined by the possibility of signing a contract with another publisher.

[21]For early one-to-one two-sided matching models in which the parties decide on money instead of contracts, see the original contribution by Shapley and Shubik (1972).

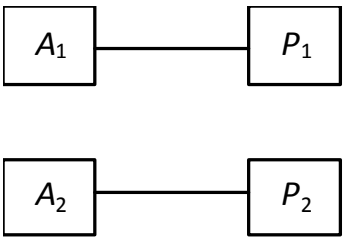

FIGURE 1. A positive assortative matching

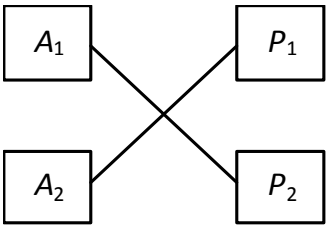

FIGURE 2. A negative assortative matching

both partners and strictly better for at least one of them. Second, the matching is efficient, in the sense that it maximizes total surplus. This property derives from competition in the market: as publishers compete among themselves for the best author, and authors compete among themselves for the best publishing partner, the resulting matching maximizes the total market surplus. If this was not the case, an alternative partnership between a publisher and an author would obtain more benefits.[22]

4.1. **Market under symmetric information.** We consider first the situation where information is symmetric, that is, there is no moral hazard problem. We check whether the equilibrium matching is positive or negative assortative or, equivalently, whether the matching that maximizes total surplus is positive or negative assortative.

[22]Equilibrium outcomes always exist. The properties of optimality that we have mentioned can be easily proven following the same arguments as those used, for example, in Alonso-Paulí and Pérez-Castrillo (2012).

From the expression obtained in Section 3.1, we can compute the joint utility of the participants under symmetric information as

$$(B+U)^* = L + \gamma\theta_A\theta_P (H-L) + \frac{1}{2}\left(\theta_P^2 + \theta_A^2\right)(H-L)^2 .$$

In the positive assortative matching $[1 \longleftrightarrow 1, 2 \longleftrightarrow 2]$, we obtain

$$\begin{aligned} (B+U)^*_{(1\longleftrightarrow 1)} &= L + \gamma (H-L) + (H-L)^2 \\ (B+U)^*_{(2\longleftrightarrow 2)} &= L + \gamma\theta_{A2}\theta_{P2} (H-L) + \frac{1}{2}\left(\theta_{P2}^2 + \theta_{A2}^2\right)(H-L)^2 \end{aligned}$$

and total surplus is

$$S^*[1 \longleftrightarrow 1, 2 \longleftrightarrow 2] = 2L + \gamma (1 + \theta_{A2}\theta_{P2})(H-L) + \frac{1}{2}\left(2 + \theta_{P2}^2 + \theta_{A2}^2\right)(H-L)^2 .$$

Following similar calculations, we obtain that total surplus in the negative assortative matching $[1 \longleftrightarrow 2, 2 \longleftrightarrow 1]$ is

$$S^*[1 \longleftrightarrow 2, 2 \longleftrightarrow 1] = 2L + \gamma (\theta_{P2} + \theta_{A2})(H-L) + \frac{1}{2}\left(2 + \theta_{P2}^2 + \theta_{A2}^2\right)(H-L)^2 .$$

To check whether the matching is positive or negative assortative we check which one generates a higher total surplus. Note that the expressions for $S^*[1 \longleftrightarrow 1, 2 \longleftrightarrow 2]$ and $S^*[1 \longleftrightarrow 2, 2 \longleftrightarrow 1]$ only differ in the term multiplying γ. Also, it is easy to see that $1 + \theta_{A2}\theta_{P2} \geq \theta_{P2} + \theta_{A2}$ is equivalent to $(\theta_{A2} - 1)(\theta_{P2} - 1) \geq 0$. Therefore, the equilibrium matching is positive assortative: Author A_1 with characteristic $\theta_{A1} = 1$ and publisher P_1 with characteristic $\theta_{P1} = 1$ are matched, and A_2 with characteristic $\theta_{A2} > 1$ and P_2 with characteristic $\theta_{P2} > 1$ are also matched. In other words, in equilibrium the best agents match among themselves and those with lower ability among themselves. As was expected, the complementarity between the abilities of publisher and author pushes for an equilibrium were the best end up working together.

The second question that we address is how much the best author profits from his ability. That is, how much more will author A_2 of ability $\theta_{A2} > 1$ receive compared to what the author of ability 1 gets? The equilibrium conditions tell us that he must receive enough so

that publisher P_1 prefers to hire A_1 (the low-ability author) instead of A_2. That is, A_2 will receive at equilibrium at least the difference between the benefits that P_1 would obtain letting author A_1 go and contracting with A_2, a difference that we denote by ΔU^*, which is[23]

$$\Delta U^* = (\theta_{A2} - 1)(H - L)\left(\gamma + \frac{1}{2}(\theta_{A2} + 1)(H - L)\right).$$

We can consider the utility ΔU^* as reflecting the "equilibrium bargaining power" of a good author. He obtains a rent in his relation with a good publisher because of the credible threat that, if he does not receive enough, he would go to an alternative publisher. This endogenous bargaining power increases with the level of complementarity (γ) and the gains from success with the alternative publisher ($H - L$), as well as with his ability advantage with respect to the other author ($\theta_{A2} - 1$).

An important implication of this model is that the bargaining power of, say, an author does not reflect absolute advantages for him with respect to the publisher. It rather reflects relative advantages of this particular author with respect to other authors in the market. Consider, for example, an author of ability θ_A. Our theory suggests that if this author lives in a market where θ_A is well above the level of the other authors' ability, then he will earn a lot of money (because the publishers will fight for him). However, the same author in a market where there are many authors of a higher ability than his will make very little money and, if the number of publishers is small, he will actually not be hired. This result may explain, for example, why reasonable singers may enjoy good salaries in markets where the average quality is low whereas they may not survive in markets where the average quality is very high.[24]

We illustrate how the stability concept works through a simple numerical example. Consider a market where $H = \frac{1}{6}$, $L = 0$, and $\gamma = \frac{1}{15}$. Also, assume that the authors' and publishers' abilities are $\theta_{A1} = \theta_{P1} = 1$ and $\theta_{A2} = \theta_{P2} = 2$.

[23]The expression ΔU^* depends in general on θ_{P1} and θ_{A1} but, in this case, they do not appear because we are assuming $\theta_{P1} = \theta_{A1} = 1$.

[24]The markets can be separated, for example, if the language of the songs is an important element in consumers' preferences.

In equilibrium, the contract has to be optimal for any pair, because otherwise the participants would change it and obtain higher profits. Using the optimality of contracts, we can compute for any partnership the parameters of the contracts and, given the level of the utility of the author, the publisher's profits. If we denote by U_1 and U_2 the utility of the authors, the contract and the profits are summarized in Table 1:

	a^*	e^*	F^*	s^*	B	U
$P1 \longleftrightarrow A1$	$\frac{1}{6}$	$\frac{1}{6}$	$U_1 + \frac{1}{72}$	$\frac{2}{5}$	$\frac{7}{180} - U_1$	U_1
$P2 \longleftrightarrow A2$	$\frac{1}{3}$	$\frac{1}{3}$	$U_2 + \frac{1}{18}$	$\frac{8}{5}$	$\frac{7}{45} - U_2$	U_2
$P1 \longleftrightarrow A2$	$\frac{1}{6}$	$\frac{1}{3}$	$U_2 + \frac{1}{18}$	$\frac{29}{30}$	$\frac{11}{120} - U_2$	U_2
$P2 \longleftrightarrow A1$	$\frac{1}{3}$	$\frac{1}{6}$	$U_1 + \frac{1}{72}$	$\frac{29}{30}$	$\frac{11}{120} - U_1$	U_1

Table 1: contracts and profits in the partnerships

The equilibrium matching and the utility that the agents get is determined simultaneously by the market competition (the stability condition). Let us notice that, in general, equilibrium outcomes are not unique; some are superior for one side of the market, some for the other. We describe the outcome where the authors get the lowest (equilibrium) utility (but the same argument can be reproduced for any other equilibrium outcome). In this outcome, the less able author, A_1, obtains his outside option because both publishers prefer the most able author A_2, that is, $U_1 = 0$.

Publishers P_1 and P_2 compete for author A_2 and this competition determines who hires A_2 and the level of utility U_2 that he obtains. Publisher P_1 would hire A_2 instead of A_1 if the benefits when hiring A_2 are higher. From the expressions in Table 1, the condition is

$$\frac{7}{180} - 0 \leq \frac{11}{120} - U_2$$

which is equivalent to

$$U_2 \leq \frac{11}{120} - \frac{7}{180} = \frac{19}{360}.$$

Therefore, the maximum utility that P_1 is ready to offer to A_2 is $U_2 = \frac{19}{360}$. Similarly, publisher P_2 prefers hiring A_2 than A_1 as long as

$$\frac{11}{120} - 0 \leq \frac{7}{45} - U_2,$$

that is,

$$U_2 \leq \frac{7}{45} - \frac{11}{120} = \frac{23}{360}$$

Publisher P_2 is ready to pay A_2 up to $U_2 = \frac{23}{360}$, which is more than the best offer publisher P_1 can possibly make. Therefore, P_2 will attract U_2 by offering him the maximum amount that P_1 would offer: $U_2 = \frac{19}{360}$ (or a slightly higher payment). This implies that the matching is positive assortative: the high-ability author is matched to the high-ability publisher (and the low-ability author to the low-ability publisher).

Moreover, in the (positive assortative) stable matching the payoffs of the four players are

P_1	A_1	P_2	A_2
$\frac{14}{360}$	0	$\frac{37}{360}$	$\frac{19}{360}$

The alternative way to check whether the matching is positive assortative is to find which matching maximizes social welfare; this is the way that we have followed in our analysis. In the numerical example, the comparison between the total surplus in the two matchings is the following:

- In the matching $P1 \longleftrightarrow A1$ and $P2 \longleftrightarrow A2$ the total surplus is $\frac{7}{180} + \frac{7}{45} = \frac{7}{36} = 0.194$
- In the matching $P1 \longleftrightarrow A2$ and $P2 \longleftrightarrow A1$ the total surplus is $\frac{11}{120} + \frac{11}{120} = \frac{11}{60} = 0.183$

which implies that the equilibrium matching is positive assortative, as we have shown in general.

4.2. **Market under double moral hazard.** We now move to a market where the participants face a double moral hazard problem. For simplicity, we concentrate in the case where

$\theta_{A2} = \theta_{P2} = \theta > 1$. In words, this means that the heterogeneity in the ability of both sides of the market is similar.

From the expressions obtained in Section 3.2, we can compute the joint utility of publisher of ability θ_P and author of ability θ_A at the optimal contract under double moral hazard:

$$(B+U)^0 = L + \gamma\theta_A\theta_P (H-L) + \frac{1}{2}\frac{\left(\theta_A^4 + \theta_A^2\theta_P^2 + \theta_P^4\right)}{\left(\theta_A^2 + \theta_P^2\right)} (H-L)^2 .$$

Using this expression we calculate the joint utility of each pair in the positive assortative matching $[1 \longleftrightarrow 1, 2 \longleftrightarrow 2]$:

$$\begin{aligned} (B+U)^0_{(1\longleftrightarrow 1)} &= L + \gamma (H-L) + \frac{3}{4}(H-L)^2 \\ (B+U)^0_{(2\longleftrightarrow 2)} &= L + \gamma\theta^2 (H-L) + \frac{3\theta^2}{4}(H-L)^2 \end{aligned}$$

and total surplus in this matching is

$$S^0 [1 \longleftrightarrow 1, 2 \longleftrightarrow 2] = 2L + \gamma\left(1+\theta^2\right)(H-L) + \frac{3}{4}\left(\theta^2+1\right)(H-L)^2 .$$

Similarly, total surplus in the case of negative assortative matching $[1 \longleftrightarrow 2, 2 \longleftrightarrow 1]$ is:

$$S^0 [1 \longleftrightarrow 2, 2 \longleftrightarrow 1] = 2L + 2\gamma\theta (H-L) + \frac{\left(\theta^4+\theta^2+1\right)}{1+\theta^2}(H-L)^2 .$$

The comparison between $S^0 [1 \longleftrightarrow 1, 2 \longleftrightarrow 2]$ and $S^0 [1 \longleftrightarrow 2, 2 \longleftrightarrow 1]$ does not necessarily lead to the same result as in the case of symmetric information; it depends on the parameters of the model. The inequality $S^0 [1 \longleftrightarrow 1, 2 \longleftrightarrow 2] \geq S^0 [1 \longleftrightarrow 2, 2 \longleftrightarrow 1]$ holds, that is, the equilibrium matching is positive assortative, if and only if

$$\gamma\left(1+\theta^2\right)(H-L) + \frac{3}{4}\left(\theta^2+1\right)(H-L)^2 \geq 2\gamma\theta (H-L) + \frac{\left(\theta^4+\theta^2+1\right)}{1+\theta^2}(H-L)^2 ,$$

or,

$$\frac{\gamma}{H-L} \geq \frac{1}{4}\frac{(\theta+1)^2}{\left(\theta^2+1\right)}.$$

The right-hand side of the inequality is a strictly decreasing function of θ that goes from $\frac{1}{2}$ for $\theta = 1$ to $\frac{1}{4}$ when θ tends to infinity. Therefore, the first implication is that, contrary to

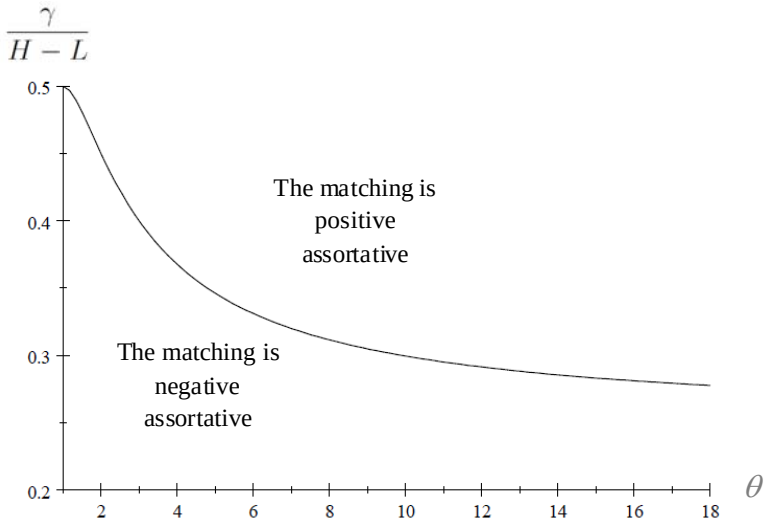

FIGURE 3. Matching under double moral hazard as a function of θ

the situation without moral hazard, the matching is not necessarily positive assortative. The matching is negative assortative when the previous inequality does not hold, that is, when the complementarity (measured by the parameter γ) is not too large, the gains from success $(H - L)$ are large, and/or the difference in abilities (measured by θ) is not very important. For example, the matching is negative assortative independently of θ if $\frac{\gamma}{H-L}$ is smaller than $\frac{1}{4}$ (whereas it is always positive assortative if $\frac{\gamma}{H-L}$ is larger than $\frac{1}{2}$).

For intermediary values of $\frac{\gamma}{H-L}$, formally for $\frac{\gamma}{H-L} \in \left(\frac{1}{4}, \frac{1}{2}\right)$, the matching is positive or negative assortative depending on the heterogeneity of the market, that is, depending on θ. To further understand the consequences of the condition, consider an example where $\frac{\gamma}{(H-L)} = 0.35$. Then, the matching is positive assortative for $\theta \gtrsim 4.8$, while it is negative assortative for $\theta \lesssim 4.8$. In words, for the best agents of both sides of the market to match among themselves in equilibria, it needs to be the case that they are superior enough in ability as compared to the other agents. Figure 3 illutrates this result.

We have shown that the moral hazard problem may have consequences not only for the shape of the contract but also for the identity of the partners who end up contracting at equilibrium. If the complementarities or the heterogeneity in ability are not very important, then a negative assortative matching is more efficient. In fact, if the complementarity parameter γ is zero, then the equilibrium matching is always negative assortative. That is, while the existence of complementarities push toward a positive assortative matching, the double moral hazard problem pushes toward a negative assortative matching because it allows for a better provision of incentives. The better agents tend to exert more effort when they are matched to a worse partner.

As before, we can compute the minimum rent (with respect to the utility obtained by the other author) that author A_2 of ability $\theta > 1$ obtains in equilibrium as the increased profits that he would induce in the publisher who does not hire him were she to switch from A_1 to A_2. If the matching is positive assortative, then we can write this level as

$$\Delta U^0 = \gamma (\theta - 1)(H - L) + \frac{1}{4} \frac{(\theta - 1)(\theta + 1)\left(2\theta^2 + 1\right)}{\left(\theta^2 + 1\right)} (H - L)^2 .$$

It is worthwhile noticing that, after simple calculation,[25] we obtain

$$\Delta U^0 - \Delta U^* = \frac{1}{4} \frac{(\theta - 1)}{\left(\theta^2 + 1\right)} \left(2\theta^3 + \theta - 1\right) (H - L)^2 > 0.$$

Therefore, the good author may benefit from the existence of the moral hazard problem because he may end up obtaining higher rents. In some sense, the existence of the moral hazard problem makes a good author more appealing for a low-ability publisher, who would be ready to pay him more, increasing his "market bargaining power" with the good publisher.

Similar calculations for the case where the matching is negative assortative under moral hazard give analogous results:

$$\Delta U^0 = \gamma\theta (\theta - 1)(H - L) + \frac{1}{4} \frac{(\theta - 1)(\theta + 1)\left(\theta^2 + 2\right)}{\left(\theta^2 + 1\right)} (H - L)^2$$

[25] And using in ΔU^* the ability $\theta_{A2} = \theta$.

and

$$\Delta U^0 - \Delta U^* = \gamma (\theta - 1)^2 (H - L) + \frac{1}{4} \frac{\theta (\theta - 1)}{\left(\theta^2 + 1\right)} \left(\theta^2 - \theta + 2\right) (H - L)^2 > 0.$$

which confirms that moral hazard may benefit authors.

5. Final comments

In the previous analysis, we concentrated on the role of royalties as a solution to a motivation problem (moral hazard) but we ignored several other aspects related to incentives in copyright contracts. We briefly discuss some of these aspects here.

First, one of the roles played by royalties in any contract is risk sharing. If authors and publishers are risk averse then sharing the revenues (that is, including a royalty into the copyright agreement) is an insurance devise (see Watt, 2006). However, risk sharing will interfere with incentive provision: the more risk averse an author is, the lower the weight of royalties on his compensation should be.[26] The trade-off between incentives and insurance is well known in the principal-agent literature, although, to our knowledge, the application to copyrights contracts has not been fully developed.

Second, we have ignored the effects of the terms of the copyright agreement on the generation of the idea. It is probably safe to say that the size of the expected return is the main motivation for creation, although the exact way in which this payment is made might be less important. In this sense, the analysis of the equilibrium utilities obtained in the market by publishers and authors may be more relevant than the analysis of the particulars of isolated contracts.

Third, we have assumed that the asymmetry of information is of the moral hazard nature, concentrating on the incentives generated after the creation has been produced by the author and the copyright agreement has been signed. However, there are other interesting aspects

[26]Publishers may also be risk averse but, in general, they have a lower risk aversion than authors. On one hand, because they pool a portfolio of books that decrease the risk they face. On the other hand, because they may have more resources than the author.

also related to asymmetry of information that can be taken into account. Indeed, it may be the case that the author and/or publisher have different information at the time of signing the copyright agreement.[27] This is an asymmetric information situation of the adverse selection type. Under adverse selection, one of the two parties has an informational advantage about her or himself. The author is often ignorant about the particulars of the market, or the expected demand for a type of creative works. The publisher may be ignorant about the quality and the reliability of the author or his work.

Let us consider one of this informational asymmetries in isolation; in particular, let us assume away any moral hazard problem. If the informed party is offering the contract, the terms of the agreement can be interpreted as a signal of the type of participant he or she is; the elements of the contract are a message to the uninformed party. For example, suppose that the publisher is the party offering a contract to the author.[28] If she proposes a payoff to the author mainly based on a fixed remuneration, and she consequently proposes to receive an important part of her own payment on a variable base, then the author can interpret this payment scheme as a signal that the publisher is confident of being able to succeed well in the commercialization of the work.

On the other hand, if the informed party is not the one proposing the copyright agreement, and the uninformed party wants to use the agreement to obtain information, then the informed party that is willing to receive a bigger part of his/her remuneration on a variable basis would be revealing that he/she is confident of having a good opportunity to succeed in the market.

Fourth, we have analyzed static relationships, that is, contracts that only last for one period. However, the duration of the contract can also be an incentive device. In art activities, the length of the agreement between intermediaries and authors may be as important as the level of compensation, in particular because long-term contracts often include clauses that prevent

[27]This type of asymmetric information affects the structure of any licensing contract (see, Macho-Stadler and Pérez-Castrillo, 1997).
[28]The results are similar if the author owns private information and offers a contract to the publisher.

or make it difficult to break them. Writers, actors or singers may sign exclusive contracts (with a publisher, a studio, or a record company) for a long period during which they cannot published, perform, or record for another firm.[29] The analysis of the incentive consequences of the duration of the contracts, particularly in market environments, is an interesting and important research question.[30]

Finally, we have not taken into account that the terms of the copyright contracts may affect the cost of the work in the market and the prize for consumers and can also play a role on infringement issues and piracy activities (see, e.g., Watt, 2006).

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[29]Some actors have had very restrictive contracts. For example, the Superman in the 1950s, George Reeves, had a contract preventing him from taking other work that might interfere with the series by including a "30-day clause", which meant that the producers could demand his exclusive services for a new season on four weeks' notice. Similarly, publishers such as comic producers, may retain the creator of the comic book character by retaining copyrights associated with this character and the stories.

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