Digital Technology and the Allocation of Ownership in the Music Industry [1]

Maija Halonen-Akatwijuka
University of Bristol and CMPO
maija.halonen@bristol.ac.uk
Tobias Regner [2]
University of Bristol and CMPO
tobias.regner@bristol.ac.uk

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Abstract:

This paper analyses the innovation process of music goods from an organizational point of view and the effects of digital technology on the allocation of property rights.

We apply the property rights theory framework introduced by Grossman-Hart-Moore (GHM) to the music industry and study the contractual relationship between artists who create music and labels who promote and distribute it.

In the spirit of GHM, different types of ownership structures are analyzed. The result confirms the current allocation of property rights as it suggests that music labels, whose role in the production process is indispensable due to their promotion and distribution knowledge, should own the copyright.

However, as digital technology advances further, alternative ways to promote and distribute music develop – labels become less indispensable. We find scenarios where the incumbent ownership structure ceases to be optimal.

Moreover, we discuss new organizational structures of the music industry. We introduce a mentor, an alternative intermediary to the label and analyze its effect on the optimal allocation of ownership. Our main result is that label ownership becomes less likely.

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[2] corresponding author

1 Introduction

The impact of new information technologies is a hot topic in economics and business. In particular the field of digital content is in the spotlight. This paper analyses the consequences of the recent advances in information processing and transmission for the ownership of copyright in the music industry. Our model is based on the property rights theory of the firm introduced by Grossman and Hart (1986) and Hart and Moore (1990). Moreover, we build on features of Aghion and Tirole (1994) in analyzing the ownership of innovation rather than physical assets.

We study the innovation process of music goods from an organizational point of view. Artists who create music and record labels who promote and distribute it are identified as the agents. They can invest effort or resources (writing songs and creating a promotion campaign, for instance) to improve the product. The outcome of their combined work (a song or album) is not predictable at the time they form the relationship. Therefore the exact nature of the piece of music is ill-defined ex ante. The contract between the artist and the label cannot specify the innovation itself but can only allocate the property rights of the innovation (the copyright).

We build on the detailed case study Regner (2003) of the music industry and formalize and extend its approach. The two most essential business areas – marketing and distribution – are related to one of the relevant parameters of the property rights model: the relative indispensability of the agents. The results of the model application are in line with the incumbent ownership structure since they predict copyright of songs to be owned by the labels. However, based on the analysis we conjecture a gradual decrease of the label's power because of technological change and its impact on the industry, and therefore a change in the allocation of property rights.

This change is, however, conditional on the actual artist type. We also introduce a third agent (a mentor, M) who offers an alternative exposure channel to newcomer artists. The motivation for this extension stems from the increasing need for new intermediaries in digital content.

We analyze when the mentor adds value and study the effect on the optimal ownership structure with three agents. M would assume the role of a venture capitalist if him owning the copyright were optimal. We analyze non-drastic technology change where the label is not replaced entirely.

In the case of non-drastic technology change adding the third agent increases value unambiguously when the mentor's and the label's investments are additive. When the investments are complementary the mentor obtains holdup power over the label's investment and the holdup problem is increased by adding the third agent. If the value of M's investment is high enough it outweighs the lower incentives for the artist and the label and the alternative intermediary adds value. The label is less likely to own the copyright because the relative importance of investments and the bargaining payoffs change in favour of the artist and the mentor.

Among other things this paper brings together features from Hart and Moore

(1990) and Rajan and Zingales (1998). Hart and Moore (1990) analyze the optimal ownership structure with a fixed number of agents. The degree of indispensability of the agents is one of the important determinants of the optimal ownership structure. They do not endogenize the number of agents and they analyze only complementary investments. Rajan and Zingales (1998) do endogenize the number of agents and also analyze different investment types. However, ownership is exogenous in their model and only the intermediaries – not the owner – invest. Our paper endogenizes the number of agents *and* the ownership structure. *All* agents invest and we analyze *different* investment types applying it to the music industry.

It is also worth to mention that different bargaining approaches within property rights theory deliver the same results in the context of our paper. De Meza and Lockwood (1998) point out that in non-cooperative bargaining ownership may demotivate in contrast to the cooperative bargaining of Grossman-Hart-Moore (GHM) that is applied here. However, taking into account investment spillovers the two approaches are found to be not so different after all. These cross effects augment the value of the asset, the investment remains in the asset even if the agent leaves and it can be appropriated by the owner. With large enough cross effects ownership does motivate as it is shown in de Meza and Lockwood (2003). In the context of the music industry, investments of artists and labels clearly do have spillovers since they directly improve the quality of the innovation as described earlier. Owning the innovation – having the copyright – motivates. The degree of cross effects is expressed by the indispensability – the (in-)ability to make use of the remaining investment without the agent.

The economic literature on copyright is well summarized in Watt (2000). However, in the existing literature the owner of copyright is taken as given. Only the relationship between the copyright holder and the consumer is analyzed. Whereas we distinguish between artist and label ownership analyzing which is more efficient in the context of technological change.

The structure of the paper is as follows. We give some background and motivation in section 2 and describe the benchmark model with two agents in section 3. Section 4 analyses the emergence of an alternative intermediary. The optimal allocation of ownership - given three agents - is studied in section 5 and section 6 concludes.

2 Digital Technology in the Music Industry

The property rights theory of the firm is a very useful framework to understand the ownership structure in the music market.[3] In the detailed case study of the music industry in Regner (2003) the two most essential business areas of the industry (distribution and marketing) are analyzed and related to the property rights theory. Recent changes in information technology culminating in peer-to-peer file sharing software like Napster are studied in order to clarify their

[3] It has also been adopted by Caves (2000) and Caves (2003) to analyze the music industry in particular and creative industries in general.

impact on the industry structure and its optimal allocation of ownership.

The main findings in the traditional music market (pre-Napster) are a label dominated retail distribution network without viable alternative and generally more efficient marketing potential for the labels. We assume the artist to be of a singer/songwriter type. He composes the songs and also plays and performs them. Thus, he provides all the artistic input.[4] The standard model with an artist and a label explains the allocation of ownership in the traditional music industry where labels own the copyright of songs. This is shown to be optimal. However, the model suggests a change in the ownership structure due to the possibilities digital technology offers to the artists. In the post-Napster scenario the labels are getting more dispensable as their retail distribution network becomes replaceable due to alternative ways of electronic distribution. The artists are able to promote their products more efficiently themselves (with digital updates of their existing fan base or through the information externalities of file sharing networks). Depending on the artist type and the exact effect of technology a move towards artist ownership appears predictable.

Now we distinguish between established artists and newcomers. The former can address their existing fan base directly. They would presumably cooperate with intermediaries for the various tasks internet-based marketing and distribution require.[5] These services are not particular and the alternative intermediaries (who might even be the old ones if the labels restructure and refocus their business concept) can be replaced on the spot market rather easily. Since we can fairly assume that the established artists do command over substantial funds, they will not encounter difficulties in compensating the labels in order to realize the ownership change.[6]

Less known artists benefit from the information externalities created by peer-to-peer networks.[7] However, they still have to compete for attention in a seemingly abundant field of new artists who are all able to utilize these information transmission channels. Intermediaries might offer new valuable services for unknown artists targeting their "need for attention" in the networked world. Moreover, the new artists cannot simply buy out labels to get ownership even if this would provide better overall investment incentives, because they do not have the financial means. An inefficient allocation of ownership would result.

Our model is inspired by this demand for new intermediaries in digital content who can address the need for attention and who can provide newcomer artists with financial resources.

[4] In the conclusions we elaborate on the results if this assumption is lifted.

[5] Web services like the design and maintenance of a web site or running an online shop for CD sales, promotion services (a concert agency), art design of booklet and cover.

[6] The artist "Prince" can be seen as an early precursor. He became exceptionally popular in the early 90s, but feuded with his record company in the middle of a long-term contract. He reluctantly fulfilled the deal only to produce his latest album with a label he founded himself. However, his motives might not be purely based on a monetary gain, but simply because of antipathy towards music labels.

[7] The reason for this are network effects. It is formally explained in Duchene and Waelbroeck (2003).

Established, famous artists with some sort of entrepreneurial spirit (to invest their money) and faith in the success of the newcomer (to credibly promote them with their own reputation) have the "capital" to provide new artists in the post-Napster scenario with an alternative to label promotion. They would function like a mentor, adopting a young artist they particularly like or one who they regard as very promising. Obviously, the established artist would pick a newcomer of his own artistic field who he can credibly recommend and promote. He would support him by linking to the newcomer web site from his own well-visited web site and endorsing him there or by taking him to concert tours to perform before the main concert etc. Generally, he would act as a venture capitalist who believes in, promotes and finances the project of the newcomer. Some aspects of this mentoring are analyzed in the following model. We will strictly focus on his role as an information intermediary promoting the new artist, leaving the financing part for later analysis.

3 The benchmark

3.1 The model

Our benchmark is a simplified version of Hart and Moore (1990) applied to the music industry. Like Aghion and Tirole (1994) we focus on the ownership of innovation rather than physical assets. There are two agents in the model: the artist, A, and the label, L. A composes and performs a piece of music, the innovation. L is needed to produce, promote and distribute the piece of music – the CD – to the final consumers. Our focus is on the question who should own the innovation, i.e. whether the artist or the label should have the copyright.

At the time A and L form the relationship the nature of the innovation is ill-defined: the song is yet to be composed. Therefore they cannot contract for the delivery of a specific innovation. Only an already composed song can be described fully. The agents can, however, contract on the ownership of the innovation, the copyright. If L has the ownership, the copyright of any song composed by A during the relationship belongs to L. While if A holds the property rights, he himself owns the copyright of his song.

Ownership of the copyright is the only instrument analyzed in this paper. We do not analyze royalties – contracts that reward A according to the number of CDs sold. This is because there are many ways the label can conceal the true number of CDs sold. Krasilovsky and Shemel (2000, p. 21-22) report that the exact sales are diluted by promotional give aways and record clubs. Moreover, recording costs are recouped by the labels against the artist's royalties. Profit sharing contracts are also problematic, because the labels have many artists working for them and the aggregate profit level does not accurately reflect the contribution of an individual artist.[8] Our focus on ownership alone is in line

[8] Even if the time 1 revenues were verifiable, agreements to share profits are of limited value since the agents can always threaten to provide a bad product (low quality recording and concerts, lacklustre promotion) or not to trade at all. (See Hart and Moore (1990) footnote

with the property rights theory.

Both agents can improve the value of the innovation by investment. The artist engages in the creative process of composing songs, practising and recording them. The label spends resources for the recording. It also invests in preliminary promotion. A's investment is denoted by i_A and L's investment by i_L. The investments are specific to this very relationship. The artist's effort of creating a song is completely linked to the actual copyright of the work, which means that his investment is entirely relationship-specific. The label needs to plan a promotion campaign before the release of the CD. Moreover, it also has to allocate recording and video production resources for the artist. These investments are also relationship-specific.

The minimum level of investment is normalized to be 0. This level already contains basic effort out of artistic curiosity, willingness to express and fun.[9] The investments are observable to A and L, but they are not verifiable to others. The value of production, the revenue from the CD, depends on both agent's investments and is given by $v(i_A, i_L)$. We assume that the agents have equally important investments, i.e. for any i'_A and i'_L $v(i'_A, i'_L) = v(i'_L, i'_A)$.[10] The cost of investment is $c(i_j)$ for $j = A, L$ and it is assumed to be linear: $c(i_j) = i_j$.

Assumption 1. $i_j \in \left[0, \overline{i}\right]$ where $\overline{i} > 0$ and $j = A, L$. $v(i_A, i_L)$ is twice differentiable in i_j. $\frac{\partial v}{\partial i_j} > 0$, $\frac{\partial^2 v}{\partial i_j^2} < 0$ and $\frac{\partial^2 v}{\partial_{i_A} \partial_{i_L}} > 0$ for $i_j \in \left(0, \overline{i}\right)$ with $\lim_{i_j \to 0} \frac{\partial v}{\partial i_j} = \infty$ and $\lim_{i_j \to \overline{i}} \frac{\partial v}{\partial i_j} = 0$.

Assumption 1 is standard and guarantees an interior solution.

The timing of the model is the following. At date 0 the agents contract on the ownership of the innovation; either A or L has the ownership of the copyright. Then the agents simultaneously choose their relationship-specific investments. At date 1 the spot contract on trade is written. Then the final version of the album is recorded and sold and the revenues are shared according to the spot contract. Also the promotion campaign, concert tours and other promotional acts with the artist take place.

If under L-ownership the relationship were to break at date 1 – after the innovation is realized – L could produce and sell the CD without A's contribution. That is, another artist would perform the song in the final recording and give concerts to promote the product. The value of the innovation without A's contribution is denoted by $v(i_L; \lambda_A)$ and the value depends on how indispensable A is. Parameter λ_A, where $0 \leq \lambda_A \leq 1$, is the degree of indispensability of A. For $\lambda_A = 0$, A is completely indispensable. Then the marginal return to L's investment without A is zero: $\partial v(i_L; \lambda_A = 0)/\partial i_L = 0$. For $\lambda_A = 1$, A is fully dispensable and the marginal return to L's investment is not affected by whether A is in the coalition or not: $\partial v(i_L; \lambda_A = 1)/\partial i_L = \partial v(i_A, i_L)/\partial i_L$. If

7.)

[9] See also Aghion and Tirole's (1994) concept of researchers' intellectual curiosity.

[10] We make this assumption to simplify the analysis. See Regner (2003) for the analysis of a model where A and L differ in the importance of investments.

the agents split under L-ownership A does not have any rights to the song he has composed and therefore he earns zero utility.

If the agents split under A-ownership, A can sell the song to the customers, but now without L promoting and distributing the product. The value of production is then $v(i_A; \lambda_L)$ and as above, the marginal return to A's investment depends on how indispensable L is, while L can only earn zero utility.

Assumption 2. $\frac{\partial v(i_i;\lambda_j)}{\partial i_i} = 0$ if $\lambda_j = 0$ and $\frac{\partial v(i_i;\lambda_j)}{\partial i_i} = \frac{\partial v(i_i,i_j)}{\partial i_i}$ if $\lambda_j = 1$.

$$\frac{\partial^2 v(i_i;\lambda_j)}{\partial i_i \partial \lambda_j} > 0 \text{ where } i, j = A, L \text{ and } i \neq j.$$

Assumption 3. $v(i_A; \lambda_L) \leq v(i_A, i_L)$ and $v(i_L; \lambda_A) \leq v(i_A, i_L)$.

Assumption 2 defines that the marginal value of agent i's investment is increasing in λ_j. The more dispensable the non-owning agent is, the higher is the marginal value of the owner's investment when he works alone. Assumption 3 implies that it is ex post efficient for the agents to produce together rather than split.

3.2 Results

Equation (1) gives the first best investments i_A^* and i_L^*:

$$\frac{\partial v(i_A^*, i_L^*)}{\partial i_A} = \frac{\partial v(i_A^*, i_L^*)}{\partial i_L} = 1 \tag{1}$$

Since date 0 contracts can be written only on ownership, the bargaining takes place after the investments are sunk. The agents foresee that part of the surplus they generate is expropriated in the bargaining process, while they pay the full cost of this investment. This leads to the hold up problem. Ownership of the copyright is allocated to minimize the holdups.

When the label owns the copyright the payoffs are:

$$\Pi_L = \frac{1}{2} v(i_A, i_L) + \frac{1}{2} v(i_L; \lambda_A) - c(i_L) \tag{2}$$

$$\Pi_A = \frac{1}{2} v(i_A, i_L) - \frac{1}{2} v(i_L; \lambda_A) - c(i_A) \tag{3}$$

Differentiating these Nash bargaining payoffs with respect to i_L and i_A yields the following incentives to invest:

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{2} \frac{\partial v(i_A, i_L)}{\partial i_L} + \frac{1}{2} \frac{\partial v(i_L; \lambda_A)}{\partial i_L} - 1 = 0 \tag{4}$$

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{2}\frac{\partial v(i_A, i_L)}{\partial i_A} - 1 = 0 \tag{5}$$

We denote L's optimal investment given by equation (4) by $i_L(\lambda_A)$ and A's optimal investment given by equation (5) by $i_A(0)$. Comparing the incentives to the first best investments (equation (1)) we see that both agents underinvest (unless $\lambda_A = 1$). Assumption 2 implies that i_L is increasing in λ_A. Owning the copyright provides the better incentives to invest for the label the more dispensable the artist is. The artist is subject to a significant holdup.

Under A-ownership the incentives are:

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{2}\frac{\partial v(i_A, i_L)}{\partial i_L} - 1 = 0 \tag{6}$$

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{2}\frac{\partial v(i_A, i_L)}{\partial i_A} + \frac{1}{2}\frac{\partial v(i_A; \lambda_L)}{\partial i_A} - 1 = 0 \tag{7}$$

Ownership improves A's incentives, but only at the expense of weakening L's incentives.

Joint surplus under L-ownership is:

$$S_L = v(i_A(0), i_L(\lambda_A)) - c(i_A(0)) - c(i_L(\lambda_A)) \tag{8}$$

and under A-ownership:

$$S_A = v(i_A(\lambda_L), i_L(0)) - c(i_A(\lambda_L)) - c(i_L(0)). \tag{9}$$

Label ownership is optimal if and only if $S_L \geq S_A$.

Remember that we have assumed that $v(i_A, i_L)$ is symmetric in i_A and i_L. From equations (5) and (6) we can see that $i_A(0) = i_L(0)$. Furthermore, by Assumption 2 we know that $i_L(\lambda_A) < i_A(\lambda_L)$ if and only if $\lambda_A < \lambda_L$. Therefore, the optimal ownership structure depends solely on the relative dispensability of the agents. A-ownership is optimal if and only if $\lambda_A < \lambda_L$. When the agents differ merely in their degree of indispensability, it is optimal that the less replaceable agent to own the innovation. This is because the most indispensable agent has the potential for the greatest holdup power as a non-owning agent. To avoid that it is better to give him the ownership.

We can now relate the results of the benchmark model to the impact of information technology in the music market. The new technology makes the labels more dispensable, because music can be distributed also electronically, not only through the labels' retail system. In the terminology of our model λ_L increases and a higher λ_L makes A-ownership more likely. The prediction of our benchmark model is that copyrights are likely to shift from the labels to the artists. While in the traditional music industry the relative indispensability was in favour of the labels ($\lambda_A > \lambda_L$), optimal ownership will change from L to A when the technology change is large enough so that $\lambda_L > \lambda_A$.

However, we ought to distinguish between established artists and newcomers. As new artists may be cash-constrained they cannot compensate the labels to get ownership.[11] Even though A-ownership might be more efficient, the labels would still own the copyright. The new artist case can lead to an inefficient ownership structure.

4 New intermediary

The technology change also opens up a role for new intermediaries. In this section we introduce an alternative way to promote music: mentoring. An experienced, well-known artist promotes the product of a newcomer. We analyze whether the new intermediary adds value when the artist owns the copyright. In Section 5 we examine the implications of the new intermediary on the optimal allocation of ownership.

We have three agents: the artist, A, and the intermediaries (the label, L, and the mentor, M). Two types of production functions are considered. Firstly, investments are *additive* in our terminology when:

$$v(i_A, i_L, i_M) = f(i_A, i_L) + g(i_A, i_M)$$

The value function is additively separable in L's and M's investment. While with *complementary* investments higher investment by an intermediary increases the marginal value of the other intermediary's investment.

$$\frac{\partial^2 v(i_A, i_L, i_M)}{\partial i_L \partial i_M} > 0$$

Both additive and complementary investments describe a situation where the technology change is non-drastic. It opens up new possibilities for marketing (mentoring), but does not replace the incumbent label altogether.

In order to solve the three player bargaining process between A, L and M we use the Shapley value. The Shapley value for agent j is:

$$\frac{1}{3}(v(i_j, i_k, i_l) - v(i_k, i_l)) + \frac{1}{6}(v(i_j, i_k) - v(i_k)) + \frac{1}{6}(v(i_j, i_l) - v(i_l)) + \frac{1}{3}v(i_j)$$
$$j, k, l = A, L, M,\ j \neq k \neq l$$

Here the agents included in the coalition are denoted by their investments in the value function. E.g. $v(i_A, i_M)$ denotes the value A and M can produce together without L's contribution. Naturally, we assume that a coalition generates revenue only if one of their agents owns the copyright. Therefore $v(i_L, i_M) = v(i_L) = v(i_M) = 0$ when A has the copyright.

We analyze two different ways for the new intermediary to enter the production process when the technology change is non-drastic. The new intermediary

[11] In the next section we introduce a mentor for the new artist. One possible way to interpret the mentor's investment is cash which makes artist ownership feasible.

either replaces the incumbent in one of his tasks (*alternative 1*) or introduces a new way to promote A's creation making the project larger (*alternative 2*). The reality lies between these two extremes. In what follows we modify the benchmark model of Section 3 to take the two alternatives into account.

In *alternative 1* L has two tasks in the benchmark case (one way to see this is to adapt the focus of Regner (2003) and assign distribution and marketing as the tasks) and M takes over one of them. For example, when M starts promoting the artist, L concentrates on distributing the product. The value of production in the benchmark is $v\left(i_A, i_L^1, i_L^2\right)$ where i_L^1 and i_L^2 are L's investments in the two tasks. The incentives for A and L under A-ownership are:

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{2}\frac{\partial v\left(i_A, i_L^1, i_L^2\right)}{\partial i_A} + \frac{1}{2}\frac{\partial v\left(i_A; \lambda_L\right)}{\partial i_A} - 1 = 0 \tag{10}$$

$$\frac{\partial \Pi_L}{\partial i_L^j} = \frac{1}{2}\frac{\partial v\left(i_A, i_L^1, i_L^2\right)}{\partial i_L^j} - 1 = 0 \quad \text{for } j = 1, 2 \tag{11}$$

When M takes over task 2 from L the value of production becomes $v\left(i_A, i_L, i_M\right)$. M's investment may be more productive than an equivalent investment by L. We capture this effect by replacing the production function $v\left(i_A, i_L, i_M\right)$ by $v\left(i_A, i_L, \omega i_M\right)$ where $\omega \geq 1$.[12]

With additive investments L's two tasks are independent and we can split up the production function: $v\left(i_A, i_L^1, i_L^2\right) = f(i_A, i_L^1) + g(i_A, i_L^2)$. Therefore the incentives for A and L in the benchmark are:

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{2}\frac{\partial f\left(i_A, i_L^1\right)}{\partial i_A} + \frac{1}{2}\frac{\partial g\left(i_A, i_L^2\right)}{\partial i_A} + \frac{1}{2}\frac{\partial f\left(i_A; \lambda_L\right)}{\partial i_A} + \frac{1}{2}\frac{\partial g\left(i_A; \lambda_L\right)}{\partial i_A} - 1 = 0 \tag{12}$$

$$\frac{\partial \Pi_L}{\partial i_L^1} = \frac{1}{2}\frac{\partial f\left(i_A, i_L^1\right)}{\partial i_L^1} - 1 = 0 \tag{13}$$

$$\frac{\partial \Pi_L}{\partial i_L^2} = \frac{1}{2}\frac{\partial g\left(i_A, i_L^2\right)}{\partial i_L^2} - 1 \quad = 0 \tag{14}$$

In *alternative 2* the project becomes larger when M joins in. L continues to provide conventional label marketing and M contributes as an information intermediary. For example M takes A to concert tours to perform before the main concert and endorses him on his web portal. Introducing the new intermediary changes the production function from $v(i_A, i_L)$ to $V(i_A, i_L, i_M)$. For $i_M > 0$ and for given investments i_A and i_L $v(i_A, i_L) < V(i_A, i_L, i_M)$ implying that the larger project is more valuable.

With additive investments we can again split up the production value:
$V(i_A, i_L, i_M) = v(i_A, i_L) + w(i_A, i_M)$.

[12] We do not analyze $\omega < 1$ as it cannot be value increasing to include a less productive agent in the team. Our interest is in if it ever can be value decreasing to include a more productive agent.

A's and L's incentives in the benchmark for both additive and complementary investments are as in equations (6) and (7) .

We assume the equivalent of Assumptions 1-3 to hold also for $f\left(i_A, i_L^1\right)$, $g\left(i_A, i_L^2\right)$, $w(i_A, i_M)$ and $V(i_A, i_L, i_M)$.

4.1 New intermediary takes over one task from incumbent

4.1.1 Additive investments

In *alternative 1* M takes over task 2 from L, while L continues to perform task 1. The value of production with additive investments is $v\left(i_A, i_L, \omega i_M\right) = f(i_A, i_L) + g(i_A, \omega i_M)$. The payoffs for the agents are:

$$\begin{aligned}\Pi_A &= \frac{1}{3}v\left(i_A, i_L, \omega i_M\right) + \frac{1}{6}v\left(i_A, i_L; \lambda_M\right) + \frac{1}{6}v\left(i_A, \omega i_M; \lambda_L\right) + \frac{1}{3}v\left(i_A; \lambda_L, \lambda_M\right) - i_A \\ &= \frac{1}{2}f(i_A, i_L) + \frac{1}{2}g(i_A, \omega i_M) + \frac{1}{2}f(i_A; \lambda_L) + \frac{1}{2}g(i_A; \lambda_M) - i_A \end{aligned} \tag{15}$$

$$\begin{aligned}\Pi_L &= \frac{1}{3}\left[v\left(i_A, i_L, \omega i_M\right) - v\left(i_A, \omega i_M; \lambda_L\right)\right] + \frac{1}{6}\left[v\left(i_A, i_L; \lambda_M\right) - v\left(i_A; \lambda_L, \lambda_M\right)\right] - i_L \\ &= \frac{1}{2}f(i_A, i_L) + \frac{1}{2}f(i_A; \lambda_L) - i_L \end{aligned} \tag{16}$$

$$\begin{aligned}\Pi_M &= \frac{1}{3}\left[v\left(i_A, i_L, \omega i_M\right) - v\left(i_A, i_L; \lambda_M\right)\right] + \frac{1}{6}\left[v\left(i_A, \omega i_M; \lambda_L\right) - v\left(i_A; \lambda_L, \lambda_M\right)\right] - i_M \\ &= \frac{1}{2}g(i_A, \omega i_M) + \frac{1}{2}g(i_A; \lambda_M) - i_M \end{aligned} \tag{17}$$

Remember that a coalition without the artist produces zero value since he holds the copyright. The value function is separable in L's and M's investments and therefore the bargaining outcome is as if A negotiates independently with each intermediary. Differentiating the payoff functions we find that the incentives for the agents are:

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{2}\frac{\partial f(i_A, i_L)}{\partial i_A} + \frac{1}{2}\frac{\partial g(i_A, \omega i_M)}{\partial i_A} + \frac{1}{2}\frac{\partial f(i_A; \lambda_L)}{\partial i_A} + \frac{1}{2}\frac{\partial g(i_A; \lambda_M)}{\partial i_A} - 1 = 0 \tag{18}$$

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{2}\frac{\partial f(i_A, i_L)}{\partial i_L} - 1 = 0 \tag{19}$$

$$\frac{\partial \Pi_M}{\partial i_M} = \frac{1}{2}\frac{\partial g(i_A, \omega i_M)}{\partial i_M} - 1 = 0 \tag{20}$$

Proposition 1 follows directly from comparing equations (12) - (14) to (18) - (20).

Proposition 1 *If investments are additive and the new agent takes over one task from the incumbent, the value of production remains unchanged if and only if* $\omega = 1$ *and* $\lambda_M = \lambda_L$. *The new agent increases value if* (i) $\omega > 1$ *or* (ii) $\lambda_M > \lambda_L$. *Allowing the third agent to join the production is never harmful.*

Proof. It is straightforward from equations (12) - (14) and (18) - (20) that the incentives are the same in the two-agent and the three-agent cases if and only if $\omega = 1$ and $\lambda_M = \lambda_L$. If $\omega > 1$, A's incentives are greater in the 3-agent case and M has higher incentives than L for the second task. If $\lambda_M > \lambda_L$ A has improved incentives in the 3-agent case. λ_M cannot be smaller than λ_L as in replacing M in production A can use the same spot market alternative as in replacing L in the 2-agent case or alternatively go back to using L for task 2. Furthermore, $\omega \geq 1$ by assumption. Therefore, adding the third agent can never lower the investments. ■

If L and M are equally productive ($\omega = 1$) and equally replaceable in task 2 ($\lambda_M = \lambda_L$), M taking over one task from L has no effect on the value of production. Because of the separability of the production function the bargaining outcome is as if A negotiates independently with each intermediary. When L and M are identical in task 2, the bargaining outcome is the same as in the two agent case[13]. Therefore, the incentives are the same too and the value of production remains unchanged when M joins in.

If M's investment in task 2 is more productive than L's, then including M in the coalition unambiguously increases the value of production. This is because the bargaining outcome is not affected by the third agent. Also if M is more dispensable than L it is beneficial to allow M to join the production. This may simply result from the fact that A has the option of going back to L to perform task 2.

With additive investments it is therefore never value decreasing to introduce the new agent.

4.1.2 Complementary investments

With complementary investments the incentives are:

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{3}\frac{\partial v\left(i_A, i_L, \omega i_M\right)}{\partial i_A} + \frac{1}{6}\frac{\partial v\left(i_A, i_L; \lambda_M\right)}{\partial i_A} + \frac{1}{6}\frac{\partial v\left(i_A, \omega i_M; \lambda_L\right)}{\partial i_A} + \frac{1}{3}\frac{\partial v\left(i_A; \lambda_L, \lambda_M\right)}{\partial i_A} - 1 = 0 \tag{21}$$

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{3}\frac{\partial v\left(i_A, i_L, \omega i_M\right)}{\partial i_L} + \frac{1}{6}\frac{\partial v\left(i_A, i_L; \lambda_M\right)}{\partial i_L} - 1 = 0 \tag{22}$$

[13] Apart from the fact that M rather than L is getting half of the surplus from task 2.

$$\frac{\partial \Pi_M}{\partial i_M} = \frac{1}{3}\frac{\partial v\left(i_A, i_L, \omega i_M\right)}{\partial i_M} + \frac{1}{6}\frac{\partial v\left(i_A, \omega i_M; \lambda_L\right)}{\partial i_M} - 1 = 0 \tag{23}$$

The incentives are clearly lower than in the benchmark for $\omega = 1$ and $\lambda_L, \lambda_M < 1$ (compare to equations (10) and (11)).

When the investments are complementary the new intermediary obtains holdup power over the artist's and the incumbent agent's investments. Unlike in the additive case the marginal value of A's and L's investments depends on whether or not M is in the coalition. Introducing the third agent increases the power problems and the incentives are weaker even if M's investment is as productive as L's.

On the other hand M's investment can be more productive than L's. For ω high enough the benefit of introducing a more productive agent to the coalition outweighs the cost of higher holdup problems as the following Proposition shows.

Proposition 2 *If investments are complementary and the new agent takes over one task from the incumbent, permitting the third agent to join under A-ownership is optimal if and only if* $\omega > \widehat{\omega}$.

Proof. For $\omega = 1$ and $\lambda_L = \lambda_M < 1$ it is clear from equations (10), (11) and (**??**) – (23) that the 2-agent case dominates. However, for $\omega \to \infty$ the 3-agent case dominates. Further $v\left(i_A, i_L, \omega i_M\right)$ is monotonically increasing in ω. Therefore, there exists $\widehat{\omega}$ for which the joint surplus in the 2-agent case equals the joint surplus in the 3-agent case. The 3-agent case dominates if and only if $\omega > \widehat{\omega}$. ■

4.2 New intermediary creates a new task

4.2.1 Additive investments

We now analyze the case when the new intermediary creates a new task and makes the project larger. When the investments of the label and the mentor are additive, the value of production is $V(i_A, i_L, i_M) = v(i_A, i_L) + w(i_A, i_M)$. The investments are then:

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{2}\frac{\partial v(i_A, i_L)}{\partial i_A} + \frac{1}{2}\frac{\partial w(i_A, i_M)}{\partial i_A} + \frac{1}{2}\frac{\partial v(i_A; \lambda_L)}{\partial i_A} + \frac{1}{2}\frac{\partial w(i_A; \lambda_M)}{\partial i_A} - 1 = 0 \tag{24}$$

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{2}\frac{\partial v(i_A, i_L)}{\partial i_L} - 1 = 0 \tag{25}$$

$$\frac{\partial \Pi_M}{\partial i_M} = \frac{1}{2}\frac{\partial w(i_A, i_M)}{\partial i_M} - 1 = 0 \tag{26}$$

A gets benchmark incentives from his production part with L (equation (7)) and additionally he also has incentives for his production part with M. Therefore, A's investment is higher than in the benchmark. The first-order condition for

L is equivalent to the benchmark (equation (6)), but since A's investment is higher than in the benchmark also L's incentives are improved at the margin. This is due to the complementary effect of M's investment. Moreover, now the third agent (under)invests as well in the new task. Total surplus therefore unambiguously increases.

Proposition 3 *If investments are additive and the new agent creates a new task, the three agent case generates more value than the two agent case under A-ownership. Allowing the third agent to join the production is optimal.*

Proof. By comparing equation (7) and (24) it is clear that A's investment is higher with three agents. Equations (6) and (25) are equivalent, but L's investment is higher in the 3-agent case, because $\frac{\partial^2 v(i_A,i_L)}{\partial i_A \partial i_L} > 0$. Additionally, M invests in the new task and therefore surplus is unambiguously higher in the 3-agent case. ■

When investments are additive, power problems are not increased by the new agent because the bargaining outcome is as if A bargains separately with L and M. Therefore, there are no costs, only benefits from the new intermediary who creates a new task. It is optimal to allow him to join in.

4.2.2 Complementary investments

When investments are complementary the incentives are as follows:

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{3}\frac{\partial V\left(i_A, i_L, i_M\right)}{\partial i_A} + \frac{1}{6}\frac{\partial V\left(i_A, i_L; \lambda_M\right)}{\partial i_A} + \frac{1}{6}\frac{\partial V\left(i_A, i_M; \lambda_L\right)}{\partial i_A} + \frac{1}{3}\frac{\partial V\left(i_A; \lambda_L, \lambda_M\right)}{\partial i_A} - 1 = 0 \tag{27}$$

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{3}\frac{\partial V\left(i_A, i_L, i_M\right)}{\partial i_L} + \frac{1}{6}\frac{\partial V\left(i_A, i_L; \lambda_M\right)}{\partial i_L} - 1 = 0 \tag{28}$$

$$\frac{\partial \Pi_M}{\partial i_M} = \frac{1}{3}\frac{\partial V\left(i_A, i_L, i_M\right)}{\partial i_M} + \frac{1}{6}\frac{\partial V\left(i_A, i_M; \lambda_L\right)}{\partial i_M} - 1 = 0 \tag{29}$$

Power problems increase with complementary investments since the bargaining is now between three rather than two agents. This tends to lower the incentives for A and L. On the other hand M's new contribution increases the marginal returns for A's and L's investment (due to the complementary effect) which increases their incentives. Therefore, it is ambiguous whether A and L have lower or higher incentives in the three agent case.

Since M increases the size of the project by definition, M's investment increases the surplus in the three agent case. If additionally A's and L's incentives are higher in the three agent case, permitting the third agent to join is optimal.

While if A's and L's incentives are lower in the three agent case, we need to weigh their lower investments with M's higher investment to find whether it is optimal to allow M to join in. The following Proposition summarizes our results in this case.

Proposition 4 *Suppose that the function* $V(i_A, i_L, i_M)$ *is replaced by* $V(i_A, i_L, \omega i_M)$ *where* $\omega \geq 0$. *If investments are complementary and M creates a new task, permitting the third agent to join is optimal if* (i) $\frac{\partial^2 V(i_A, i_L, \omega i_M)}{\partial i_j \partial i_M} >> 0$ *for* $j = A, L$ *or* (ii) $\omega > \widetilde{\omega}$. *Restricting production to two agents is optimal if* $\omega \to 0$.

Proof. Comparing equations (6) and (7) to (27) and (28) we see that A and L have higher incentives in the 3-agent case if $\frac{\partial^2 V(i_A, i_L, \omega i_M)}{\partial i_j \partial i_M} >> 0$ for $j = A, L$. Then the 3-agent case dominates since there is additionally M's investment. Even if A's and L's incentives are worse, if the value of M's investment is very large, the 3-agent case dominates. This is the case when ω is very high ($\omega > \widetilde{\omega}$).

Instead, if $\omega \to 0$ the value of M's investment is negligible and clearly the 2-agent case dominates. ■

Proposition 4 shows that the value of the new intermediary depends on the value of his investment and on the effect of his investment on the marginal returns of the existing agents. The new intermediary always obtains some holdup power when investments are complementary. But when he has a valuable investment which increases the project's value directly and indirectly via making the existing agents' investments more productive at the margin, it is beneficial to join forces with the new intermediary. While if his investment is of low value and has not much complementary effects to the existing agents, the new intermediary only introduces power problems and it is better to restrict the production to two agents.

4.3 Summary

In this section we have analyzed the impact of a new intermediary – the mentor – on the value of production. Given artist ownership we have studied, whether it is beneficial to let M join under different investment types (additive or complementary) and different ways of cooperation (M creates a new task or he takes over an existing one from L). We have shown that a third agent generally improves the value of production. However, if the mentor's and the label's investments are complementary, the mentor has to be sufficiently productive, because he obtains holdup power over the label and the artist. We determine parameter values for M's efficiency of $\omega > \widetilde{\omega}$ in alternative 1 and $\omega > \widehat{\omega}$ in alternative 2 for this to be true. If these two conditions hold, letting the new intermediary join is beneficial in all four cases.

This leads to the question of what ownership structure is optimal when there are three agents taking part in production. That is the focus of Section 5: can the joint surplus be further increased by allocating the ownership from A to

one of the intermediaries? If it is not optimal for M to join the production, the benchmark analysis of Section 3 determines the owner of the copyright.

Notice that it is not necessary to repeat the analysis of this section for other ownership structures. For example suppose A-ownership is optimal in the two-agent case and we find that M increases value under A-ownership: $S_A^2 < S_A^3$ where S_i^n denotes joint surplus with n agents when i has the copyright. Then if shifting copyright from A to M further increases the joint surplus $\left(S_A^3 < S_M^3\right)$, it implies that $S_A^2 < S_M^3$. In other words, allowing the third agent to join is optimal also when taking into account that ownership may change.

Finally, we compare our results briefly to Rajan and Zingales (1998). In their paper an entrepreneur E owns the asset, but he does not invest. Instead, the managers $M1$ and $M2$ invest and the question is how many managers should be granted access to maximize profit. Their definition of additive investments is different from ours. When the investments are additive the production function is $v\left(\sum i_j\right)$ and $M1$'s investment affects $M2$'s investment due to the function's concavity. Therefore, the individual investment level of the managers is reduced, but total investment is larger than if one had been given access. However, the collective net payoff of two managers is lower than a single manager would get and therefore E grants access to two managers. When they assume complementary investments access granted to two managers leads to a lower investment level than if only one manager had access because of the greater holdup power. Due to the assumption of one manager being able to invest in both tasks, the entrepreneur should allow access to only one manager.

5 Optimal allocation of ownership

In this section we relax the assumption that A owns the copyright and analyze the optimal allocation of ownership.

In the two agent environment of Section 3 the optimal ownership structure merely depended on which agent – A or L – is more indispensable. Artist ownership was optimal if and only if $\lambda_A < \lambda_L$. We now find out whether in the three agent environment the same result holds. Therefore, we compare the incentives under A-ownership examined in Section 4 to the incentives when one of the intermediaries owns.

5.1 New intermediary takes over one task from incumbent

5.1.1 Complementary investments

We start the analysis this time from the complementary investments as that is the simpler case. If one of the intermediaries – let us assume L – owns the innovation, then the incentives are:

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{3}\frac{\partial v(i_A, i_L, \omega i_M)}{\partial i_A} + \frac{1}{6}\frac{\partial v(i_A, i_L; \lambda_M)}{\partial i_A} - 1 = 0 \tag{30}$$

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{3}\frac{\partial v(i_A, i_L, \omega i_M)}{\partial i_L} + \frac{1}{6}\frac{\partial v(i_A, i_L; \lambda_M)}{\partial i_L} + \frac{1}{6}\frac{\partial v(i_L, \omega i_M; \lambda_A)}{\partial i_L} + \frac{1}{3}\frac{\partial v(i_L; \lambda_A, \lambda_M)}{\partial i_L} - 1 = 0 \quad (31)$$

$$\frac{\partial \Pi_M}{\partial i_M} = \frac{1}{3}\frac{\partial v(i_A, i_L, \omega i_M)}{\partial i_M} + \frac{1}{6}\frac{\partial v(i_L, \omega i_M; \lambda_A)}{\partial i_M} - 1 = 0 \quad (32)$$

Remember that a coalition without L, the copyright holder, produces zero value.

We have assumed that in the benchmark A and L have equally important investments so that $v(i'_A, i'_L, i'_L) = v(2i'_L, \frac{i'_A}{2}, \frac{i'_A}{2})$ for any i'_A and i'_L. Then M taking over task 2 from L will make A's investment relatively more important than L's investment. Furthermore, A's investment is also more important than M's investment as long as M is not significantly more productive in task 2 than L $(\omega < 2)$. We need to account for these factors when analyzing the optimal ownership structure. It is the changes in the relative importance of investments that will alter the results on the optimal ownership structure.

Proposition 5 *If the investments are complementary, the introduction of a new intermediary who takes over one task from L makes L-ownership less likely.*

Proof. Suppose that $\lambda_A = \lambda_L = \lambda_M$. We analyze this case to demonstrate how the relative importance of investments alone affects the optimal ownership structure. Recall that in the 2-agent case ownership did not matter. Comparing the incentives under A-ownership (equations (**??**) $-$ (23)) to those under L-ownership (equations (30) $-$ (32)) we see that M has the same incentives in both cases and A's and L's incentives are symmetric. Since A's investment is more productive, A-ownership dominates L-ownership.

We can obtain the incentives under M-ownership by swapping subscripts L and M in (30) $-$ (32). A's investment is the most important if and only if $\omega < 2$. In this case A-ownership is optimal. While for $\omega > 2$ M's investment is the most productive and M-ownership is optimal. Compared to the 2-agent case L-ownership is less likely.

Then suppose that $\omega = 1$ and the investments are equally important so that $v(i'_A, i'_L, i'_M) = v(i'_A, i'_M, i'_L) = v(i'_M, i'_L, i'_A)$ for any given i'_A, i'_L and i'_M. This is clearly not true in the case we analyze, but this helps us to demonstrate how the second force, the relative indispensability of the agents, alone affects the optimal ownership structure in the 3-agent setup. Comparing equation (23) to (32) we see that M has worse incentives under L-ownership if and only if $\lambda_A < \lambda_L$ (by Assumption 2). (22) and (30) demonstrate that L has the same incentives under A-ownership as A has under L-ownership. Finally, from (**??**) and (31) we conclude that L has worse incentives as the owner than A if and only if $\lambda_A < \lambda_L$. Therefore, A -ownership dominates L-ownership if and only if $\lambda_A < \lambda_L$. Similar comparisons with M-ownership prove that if the agents have

equally important investments, it is optimal for the most indispensable agents to own the innovation. We use this result in the following proofs.

Now we come back to the case where either A's or M's investment is the most productive. Suppose that the agents are not equally indispensable. We assume that $\lambda_M \geq \lambda_L$ as explained in the proof of Proposition 1. If $\lambda_A < \lambda_L$ and $\omega < 2$, then A-ownership is optimal – as in the 2-agent case – since A is the most indispensable and the most productive agent. If $\lambda_A < \lambda_L$ and $\omega > 2$, then there is a trade-off between giving the ownership to the most indispensable agent (A) or to the most productive agent (M).

If $\lambda_A > \lambda_L$, then it is optimal for either the most indispensable agent (L) or the most productive agent (A or M) to own, while in the 2-agent case L-ownership is optimal. Again, in the 3-agent case L-ownership is less likely. ■

In the benchmark the optimal ownership depends only on the relative indispensability. When M joins the relative importance of investments changes in favour of either A or M which implies that L-ownership emerges for a smaller parameter range than in the two-agent case.

5.1.2 Additive investments

When the investments are additive the incentives under L-ownership are (see Appendix):

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{2}\frac{\partial f(i_A, i_L)}{\partial i_A} + \frac{1}{3}\frac{\partial g(i_A, \omega i_M)}{\partial i_A} + \frac{1}{6}\frac{\partial g(i_A; \lambda_M)}{\partial i_A} - 1 = 0 \qquad (33)$$

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{2}\frac{\partial f(i_A, i_L)}{\partial i_L} + \frac{1}{2}\frac{\partial f(i_L; \lambda_A)}{\partial i_L} - 1 = 0 \qquad (34)$$

$$\frac{\partial \Pi_M}{\partial i_M} = \frac{1}{3}\frac{\partial g(i_A, \omega i_M)}{\partial i_M} + \frac{1}{6}\frac{\partial g(\omega i_M; \lambda_A)}{\partial i_M} - 1 = 0 \qquad (35)$$

When the investments are additive the agents bargain independently over the two parts of the production function, $f(i_A, i_L)$ and $g(i_A, \omega i_M)$. The value $f(i_A, i_L)$ is shared between A and L, which explains why f-terms in equations (33)−(35) are multiplied by $\frac{1}{2}$. While the bargaining over $g(i_A, \omega i_M)$ is between all three agents. A and M interact in production and L as the owner of the innovation has a stake, too. This is why g-terms in equations (33) − (35) are multiplied by $\frac{1}{3}$ and $\frac{1}{6}$.

When the investments are additive A's crucial role in production affects the bargaining outcome. A is the agent who interacts with both intermediaries while each intermediary only interacts with the artist. This is why in the first-order conditions under A-ownership (18) − (20) we only have $\frac{1}{2}$ as the multiplier. When A is both the owner and the production partner, the bargaining over both parts of the production function is between just two agents. While if one of the intermediaries owns the copyright, one part of the bargaining is between three agents. A-ownership therefore tends to reduce the holdup problems when the new intermediary is introduced.

The second force that affects the ownership structure is the same as with complementary investments: when M takes over one task from L the relative importance of the investments changes. Depending on ω either A's or M's investment becomes the most productive.

Proposition 6 *If the investments are additive, the introduction of an intermediary who takes over one task from L makes L-ownership less likely.*

Proof. In the Appendix. ■

In the two-agent setup the optimal ownership depends only on relative indispensability. When M joins in two new forces are introduced: A gains a central role in the production process and the relative importance of investments changes in favour of either A or M. Both forces work against L-ownership and therefore L-ownership is less likely in the three-agent case.

5.2 New intermediary creates a new task

5.2.1 Complementary investments

When the investments are complementary and M makes the project larger the incentives under L-ownership are:

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{3}\frac{\partial V(i_A, i_L, i_M)}{\partial i_A} + \frac{1}{6}\frac{\partial V(i_A, i_L; \lambda_M)}{\partial i_A} - 1 = 0 \tag{36}$$

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{3}\frac{\partial V(i_A, i_L, i_M)}{\partial i_L} + \frac{1}{6}\frac{\partial V(i_A, i_L; \lambda_M)}{\partial i_L} + \frac{1}{6}\frac{\partial V(i_L, i_M; \lambda_A)}{\partial i_L} + \frac{1}{3}\frac{\partial V(i_L; \lambda_A, \lambda_M)}{\partial i_L} - 1 = 0 \tag{37}$$

$$\frac{\partial \Pi_M}{\partial i_M} = \frac{1}{3}\frac{\partial V(i_A, i_L, i_M)}{\partial i_M} + \frac{1}{6}\frac{\partial V(i_L, i_M; \lambda_A)}{\partial i_M} - 1 = 0 \tag{38}$$

The incentives are symmetric to the first order conditions under A-ownership (equations (27) - (29)).

Now suppose that when the project becomes larger, M's investment is equally important to A's and L's investments, i.e. $V(i'_A, i'_L, i'_M) = V(i'_A, i'_M, i'_L) = V(i'_M, i'_L, i'_A)$ for any given i'_A, i'_L and i'_M. Then clearly the optimal ownership structure depends solely on the relative indispensability of the agents – just as in the two-agent case. If the new intermediary is relatively dispensable ($\lambda_M > \min\{\lambda_A, \lambda_L\}$), then introducing the third agent does not induce a change in the ownership of innovation. While if the nature of the service the new intermediary is providing is so crucial that without it A's and L's investments do

not have much value ($\lambda_M < \min\{\lambda_A, \lambda_L\}$), then it is optimal for M to act as a venture capitalist and own the innovation.[14]

When M joins in, the relative importance of investments may well change and it is not a priori clear what way. If the new task is very valuable, M's investment becomes the most important. While if the new task is not very valuable in itself but M creates value mainly through complementarities with A (respectively L) then A's (respectively L's) investment becomes the most productive.

The two forces at work that determine the optimal ownership structure are the relative indispensability of the agents and the relative importance of the investments. In this case, unlike in the other cases we have analyzed, we cannot say which way these forces move when M joins in. To be consistent with the other cases, we state in the following proposition some sufficient conditions for L-ownership to become less likely when M joins in.

Proposition 7 *If the investments are complementary and M creates a new task, L-ownership becomes less likely if:*

(i) $\lambda_M < \lambda_L < \lambda_A$ and the agents have equally important investments.

(ii) Either M's or A's investment is more productive than L's investment and $\lambda_A = \lambda_L = \lambda_M$.

Proof. *(i)* If $\lambda_M < \lambda_L < \lambda_A$ and the agents have equally important investments, then L-ownership is optimal in the two-agent case and M-ownership is optimal in the three-agent case. Therefore M joining in makes L-ownership less likely.

(ii) If $\lambda_A = \lambda_L = \lambda_M$, ownership does not matter in the two-agent case and in the three-agent case it is optimal for the agent with the most important investment to own the copyright. If L's investment is not the most productive, then L-ownership is less likely in the three-agent case. ■

5.2.2 Additive Investments

The investment incentives under L-ownership are given by (33) − (35) by replacing f by v and g by w. We have assumed that in the benchmark production function $v(i_A, i_L)$ the investments are equally important. When M joins in the surplus is increased by $w(i_A, i_M)$. Since in $v(i_A, i_L)$ A's and L's investments are equally important, it must be that in $v(i_A, i_L) + w(i_A, i_M)$ A's investment is more important than L's investment, because A interacts with both L and M in production. The relative importance of A's and M's investments depends on the nature of the service the new intermediary is providing. If M's service is absolutely crucial to survive in the digital age, M's investment is the most important. While if the two intermediaries are equally productive, A's investment is the most important. This is very similar to alternative 1. When M joins in,

[14] When M takes over task 2 from L we assumed that $\lambda_M \geq \lambda_L$ since M could be replaced by the same spot-market alternative than L – or by L. While when M creates a new task it is possible that $\lambda_M < \lambda_L$.

the relative importance of investments changes in favour of either A or M. The only difference is the source of the effect. In alternative 1 it depends on how much more productive M is in task 2 than L while in alternative 2 it depends on the value of the new service M is providing.

The analysis is similar to alternative 1. When investments are additive and M joins in (i) the relative importance of investments changes in either A's or M's favour and (ii) A gains a central role in production. Both forces work against L-ownership and therefore L-ownership becomes less likely as with alternative 1. The new possibility compared to alternative 1 is that we can have $\lambda_M < \lambda_L$, i.e. the new intermediary can be more indispensable than the incumbent. This is yet another possibility to make L-ownership less likely in the three-agent case.

Proposition 8 *If investments are additive, the introduction of a new intermediary who creates a new task makes L-ownership less likely.*

5.3 Summary

We have analyzed the effect of digital technology on the allocation of copyright in four different cases. In three cases we show that the labels are less likely to own copyrights when the new intermediary is introduced.[15] Either artist ownership becomes more likely or the mentor owns the innovation and acts as a venture capitalist.

Above we have studied the optimal allocation of ownership by examining which structure gives the highest total surplus. It is also interesting to look at the composition of the total value. When the technology change leads to a shift from label ownership to the artist holding the copyright, the relative contribution of the artist increases in the total value of the piece of music. In other words, the main element of music in the digital age is likely to be the improved quality of the music itself, while the era of label ownership can be described by relatively low quality music which is packaged and marketed well.

Finally, we have assumed that λ_L remains constant when M is introduced. It is plausible that λ_L increases – L becomes more replaceable – because of the new intermediary. This makes L-ownership even less likely than the results of this section predict.

6 Conclusions

Our property rights analysis of the music industry in the information society results in three main findings. Firstly, it becomes less likely that record labels own copyrights. In the two agent case this is caused by the impact of digital technology and the resulting loss of indispensability on the part of the label. In the three agent environment – additionally to the direct consequences of technology change – the relative importance of the investments and the bargaining payoffs change in favour of the artist or the mentor. This makes the

[15] In the fourth case the results are ambiguous.

label less likely to own the copyright. Secondly, it is optimal to let the third agent (the mentor) join in when the investments are additive. Under complementary investments the mentor must be sufficiently productive to allow him to join in. Finally, we believe our concept of mentoring describes an interesting and efficiency-improving role of an information intermediary for digital content that has not been outlined before.

In this paper we analyze the implications of new technology on the allocation of ownership in the music industry. The new technology opens up alternative distribution and promotion channels to the traditional labels. In the terminology of the property rights theory the labels become more dispensable. For a large enough change in indispensability the optimal ownership structure shifts from label ownership to artist ownership. For established, cash-endowed artists acquiring ownership is feasible, while the newcomers lack the funds to compensate the label ex ante. This leads to an inefficient ownership structure.

We introduce an alternative arrangement where an established artist becomes a mentor to the newcomer. We analyze the two extremes of a non-drastic technology change: The mentor creates a new task or he takes over one of the label's traditional tasks and the label focuses on the remaining one. If the mentor's and the label's investments are additive, including the third agent unambiguously increases the value of production compared to the two agent case. While if the mentor's and the label's investments are complementary, the mentor obtains holdup power over the label and the artist. Adding the third agent reduces the value of production unless the mentor's investment is productive enough to compensate for the power problems.

We compare artist and intermediary ownership to find the optimal allocation of copyright in the three agent case. Under both complementary and additive investments either the artist or the mentor's relative importance of investment increases. The artist also assumes a crucial role in the production under additive investments which leads to a higher bargaining payoff for him. Subsequently label ownership becomes less likely. Therefore, artist ownership dominates unless the importance of the mentor's investment or his indispensability is high enough. This would lead to mentor ownership, i.e. venture capitalism.

Our model predicts several changes for the future music industry. The role of the mentor has already been described at length. He is a new intermediary for digital content and – if his input is essential enough – he invests in the fortunes of a new artist as a venture capitalist. Another aspect of the model affects the actual quality of music in the future. As the label ownership becomes less likely, the relative contribution of the artist increases and the artistic input tends to dominate. However, label ownership is still possible if the label manages to remain indispensable. This is particularly realistic when the artistic input does not come from one artist alone. If the assumption of the artist being a singer/songwriter is relaxed and we consider so-called boygroups where the artists merely sing – with the label providing the rest of the artistic inputs (writing songs, choreography) plus the essential promotion of the band – then it becomes clearer that label ownership still has its place. Therefore, we can distinguish between the production of music under label ownership where the

label inputs like promotion matter most and the creation of music under artist ownership where the artistic input is essential.

The analysis will be extended to drastic changes in technology where the label becomes obsolete. The established artist has then the option of going independent, while the newcomer can choose to work with either the label or the mentor.

Moreover, it is useful to think in the future how these results can shed light on the allocation of ownership in other areas of digital content, e.g. publishing or digital art. An interesting application of the framework might be the realm of academic writing and publishing with researchers in academia taking the role of the artist, traditional publishers of journals in the role of the labels and upcoming electronic journals as the new intermediaries.

7 Appendix

To derive equations (33) − (35) we use equations (30) − (32) and take into account that $v(i_A, i_L, \omega i_M) = f(i_A, i_L) + g(i_A, \omega i_M)$. This gives us the first-order conditions as:

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{3}\left[\frac{\partial f\left(i_A, i_L\right)}{\partial i_A} + \frac{\partial g\left(i_A, \omega i_M\right)}{\partial i_A}\right] + \frac{1}{6}\left[\frac{\partial f\left(i_A, i_L\right)}{\partial i_A} + \frac{\partial g\left(i_A; \lambda_M\right)}{\partial i_A}\right] - 1 = 0$$

$$\Leftrightarrow \frac{1}{2}\frac{\partial f\left(i_A, i_L\right)}{\partial i_A} + \frac{1}{3}\frac{\partial g\left(i_A, \omega i_M\right)}{\partial i_A} + \frac{1}{6}\frac{\partial g\left(i_A; \lambda_M\right)}{\partial i_A} - 1 = 0$$

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{3}\frac{\partial f\left(i_A, i_L\right)}{\partial i_L} + +\frac{1}{6}\frac{\partial f\left(i_A, i_L\right)}{\partial i_L} + \frac{1}{6}\frac{\partial f\left(i_L; \lambda_A\right)}{\partial i_L} + \frac{1}{3}\frac{\partial f\left(i_L; \lambda_A\right)}{\partial i_L} - 1 = 0$$

$$\Leftrightarrow \frac{1}{2}\frac{\partial f\left(i_A, i_L\right)}{\partial i_L} + \frac{1}{2}\frac{\partial f\left(i_L; \lambda_A\right)}{\partial i_L} - 1 = 0$$

$$\frac{\partial \Pi_M}{\partial i_M} = \frac{1}{3}\frac{\partial g\left(i_A, \omega i_M\right)}{\partial i_M} + \frac{1}{6}\frac{\partial g\left(i_M; \lambda_A\right)}{\partial i_M} - 1 = 0$$

Proof of Proposition 6. We first analyze the case where $\lambda_A = \lambda_L = \lambda_M =$

1. The incentives under A-ownership by Assumption 2 are (from equations (18) − (20)) :

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{\partial f(i_A, i_L)}{\partial i_A} + \frac{\partial g(i_A, \omega i_M)}{\partial i_A} - 1 = 0 \tag{39}$$

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{1}{2}\frac{\partial f(i_A, i_L)}{\partial i_L} - 1 = 0 \tag{40}$$

$$\frac{\partial \Pi_M}{\partial i_M} = \frac{1}{2}\frac{\partial g(i_A, \omega i_M)}{\partial i_M} - 1 = 0 \tag{41}$$

And incentives under L-ownership are (from equations (33) − (35)):

$$\frac{\partial \Pi_A}{\partial i_A} = \frac{1}{2}\frac{\partial f\left(i_A, i_L\right)}{\partial i_A} + \frac{1}{2}\frac{\partial g\left(i_A, \omega i_M\right)}{\partial i_A} - 1 = 0 \tag{42}$$

$$\frac{\partial \Pi_L}{\partial i_L} = \frac{\partial f\left(i_A, i_L\right)}{\partial i_L} - 1 = 0 \tag{43}$$

$$\frac{\partial \Pi_M}{\partial i_M} = \frac{1}{2}\frac{\partial g\left(i_A, \omega i_M\right)}{\partial i_M} - 1 = 0 \tag{44}$$

When all the agents are dispensable the owner receives the full marginal return to his investment while the non-owners receive half of the return to their investment at the margin. Then it is optimal for the most productive agent (A or M) to own the innovation. In the two-agent case ownership does not matter. This case demonstrates the first force to work against L-ownership in the three-agent setup.

Next we analyze a case where $\lambda_A = \lambda_L = \lambda_M \neq 1$. Again in the two-agent case both A- and L-ownership generate the same total surplus. We analyze this case by comparing equations $(33)-(35)$ to $(18)-(20)$. The symmetry disappears from the first-order conditions when the agents are not fully dispensable because of A's central role in the production process. A has a stake in bargaining over both $f(i_A, i_L)$ and $g(i_A, \omega i_M)$ whether he is the owner of the copyright or not, because he interacts in production with both intermediaries. If one of the intermediaries owns the copyright, one part of the bargaining is between three agents: the two producers and the owner. Compared to the case where all the agents are dispensable A-ownership is optimal for higher ω. A's central role in the production process is the second force to work against L-ownership in the 3-agent setup.

Finally we analyze the case where the agents differ in the degree of indispensability. If $\omega < 2$ and $\lambda_A = \min\{\lambda_A, \lambda_L, \lambda_M\}$, A-ownership is optimal because in addition to being the most productive agent and having a central role in the production process A is the most indispensable agent. In other cases there is a trade-off between giving the ownership to the most productive agent (A or M), the most indispensable agent (A, L and M) or to the agent in central role in production (A). In the 2-agent case L-ownership is optimal if and only if $\lambda_L < \lambda_A$, while in the 3-agent case $\lambda_L < \lambda_A$ is a necessary but not a sufficient condition for L-ownership to be optimal. It is clear that L-ownership is less likely in the 3-agent setup. Q.E.D.

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