Subsidies or Tax Breaks Versus Intellectual Property Rights: Dual Markets*

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Abstract

Intellectual property rights are monopoly rights, which have undesirable welfare properties. Therefore, several studies suggest to use rewards as incentives for innovation instead. However, these studies have thus far had little effect on actual policy, possibly because such rewards may be difficult to implement in practice. We suggest a way of providing incentives to originators that is easy to implement. This is possible if there is an additional market in which the originator operates, where copying is not easily possible. Taking the music industry as example, copyrights in the records market could be replaced by subsidies or tax breaks in the market for live performances. We provide a modeling framework that can be used to analyze in which cases the replacement of intellectual property rights in one market with subsidies in another market is welfare improving or even pareto efficient.

JEL codes: O34, O38, D47, O31, L12

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1 Introduction

There is a longstanding debate on how innovation and creativity should be incentivized. The standard in today's world is to assign intellectual property rights, which are monopoly rights on an idea or a creative work, awarded to its originator. However, monopolies are in general inefficient and intellectual property rights have thus harmful effects. This has long been known in economics. The harmful effects of intellectual property rights are compellingly described in the book by Boldrin and Levine (2008).

In some cases, there are arguments for abolishing intellectual property rights without substitute (e.g., Bessen and Maskin, 2009; empirical evidence that this can be beneficial can be found in Biasi and Moser, 2020). However, the standard argument in favor of intellectual property rights is that there need to be incentives to spur innovation and creativity and that it is only fair if the originators of creative works or innovations receive some sort of monetary remuneration for their work (which may, without intellectual property rights and without other forms of compensation, not accrue, because the ideas and works can be copied for free).

Because of the inefficiency of intellectual property rights on the one hand and the wish for compensation for the innovator or artist on the other, scholars have been looking for other forms of compensation than awarding monopoly rights. In several studies, researchers find that rewards or prizes can be better alternatives than awarding monopoly rights (e.g., Shavell and Van Ypersele, 2001; Davis, 2004; Gandjour and Chernyak, 2011; Brunt et al., 2012; Chari et al., 2012; for an overview, see Abramowicz, 2019). Rewards have been shown to be superior to intellectual property rights in several studies, but this research has only had a limited impact on actual policy. A reason could be that such rewards are difficult to implement. It may be relatively easy to show that a government could theoretically do well with assigning rewards to innovations of a certain quality, observed with or without noise; in practice, the sheer number of innovations and creative works plus the difficulty of assessing their quality make it difficult to use rewards for compensation (of course, also the implementation and enforcement of intellectual property rights is not necessarily easy: complicated law suits and threats thereof impose a burden on society).

It is thus important to understand whether incentive systems can be designed that share the key desirable properties of rewards (incentivizing innovation without the harm from monopoly rights) while being simple to implement. This is where our paper is situated. We suggest to use (in some cases) subsidies instead of rewards or intellectual property rights. We do not suggest subsidies in the same market of innovation. Instead, we rely on dual markets: this means that in addition to the market in which the originator can sell the creation, there needs to be a market that is different from the market where copying could easily take place, in which innovators or artists are also active.

Subsidies cannot be implemented as easily in the main market of the innovation. The reason is that, in the absence of monopoly rights to the originator, the government does not have a market price to base the subsidy on (because copying is possible at no or low marginal cost). When a second market exists in which copying is not easily possible, a simple subsidy can be implemented (as a percentage of the price in the second market) which may compensate the originator for not receiving monopoly rights in the first (the main) market. The easiest form of a subsidy is probably the reduction of a tax. With value added tax (VAT) rates of about 20–25% in many countries worldwide (especially in Europe), applying a reduced VAT rate in the second market is an extremely easy and efficient way to implement such a subsidy (reduced VAT rates often exist for some product categories anyways, for instance for food). In practice, there is a substantial difference between a tax break and a subsidy where the government transfers money, bureaucratically and concerning opportunities for fraud, but theoretically, there is no big difference: both cases constitute a transfer of money from the government to the recipient (consequently, the model shown in this paper does not distinguish between the two; we simply refer to the transfer as a subsidy most of the time).[1]

[1] In the EU, such subsidies would not be considered state aid, as they would be available to all individuals

For applications, we like to think first and foremost about situations in which intellectual property rights are assigned as copyrights, such as music and movies. This makes things simple, as the goods can most easily be thought of as final consumption goods rather than production inputs and as obvious second markets exist. However, the model can similarly be applied to other areas (note that music and movies alone are already very large areas; these might be optimal starting points if reforms are introduced slowly industry by industry, as long as the reforms are beneficial).

Music can easily be copied when consumed at home, because CDs and music files on the computer can easily be copied (basically for free). However, musicians do not only earn money from selling CDs and mp3 files. They also earn money from live performances. The market for live performances is the second market. In that market, copying is difficult: while there is no difference between listening to an original mp3 file of your favorite song and a copy of this file, there is a big difference between attending a concert of your favorite band and one of a different band playing the songs of your favorite band. Of course, musicians also earn money from other sources. Only a small fraction of a musician's income is typically directly related to copyrights: only about 12% in the US, while the largest shares of income are live performances with about 28% and teaching with about 22% (DiCola, 2013). The situation is comparable in other countries (e.g., China or Switzerland; Liu, 2014; Perrenoud and Bataille, 2017). For simplicity, we focus on subsidies in only one other market, but the analysis could easily be extended to multiple other markets (for instance, removing copyrights in music records market and introducing subsidies for both, concerts and music teaching).

A similar situation exists for movies. One could eliminate copyrights for CDs and digital files and compensate movie companies by subsidizing the screening in cinemas.[2] There are also other cases in the area of intellectual property rights, with something like second or third

and companies.

[2]To be precise, one would not completely eliminate copyrights for movies in this case: instead, copyrights would only be removed for non-commercial use, so that cinemas would still have to pay for the movies (so that the subsidy in the second market can be effective).

markets. Researchers, for instance, publish articles that can easily be copied and distributed, but they also make money by teaching at universities and similar institutions – with the pay for their teaching in general positively correlated to their research output. Forgetting for a moment about the fact that it is in general publishers and not the authors themselves who hold the copyrights of the articles, it would be possible to eliminate copyrights on scientific articles and instead subsidize teaching in higher education (or increase such subsidies if they already exist for other reasons).[3]

Dual markets do not need to exist in all areas. In areas where dual markets exist, it is not clear that a subsidy in the second market is better than granting monopoly rights. For instance, authors of books make money in public readings in addition to the money they receive from the selling of the books, but one may argue that the second market of public readings seems too small to be useful as compensation for removing copyrights in the book market. Each area needs to be assessed by itself. In the music market, the fact that money from the records market only makes up for a small fraction of a musician's income makes it likely that moderate subsidies (e.g., exemptions from the VAT) in the market for live music would make everyone better off, including the musicians.

What we provide here is a simple analytical framework with which one can assess whether the introduction of a subsidy in the second market in exchange for a removal of intellectual property rights can lead to an improvement in social welfare or even to a pareto improvement (signifying that everyone, including the originator, is better off).

We show the model for the status quo in Section 2, with intellectual property rights in the first market (in which the innovation takes place) and without subsidy in the second market. There is a monopoly in both markets: due to the assignment of intellectual property rights in the first and naturally in the second market. Section 3 contains the model for the case that intellectual property rights in the first market are removed, while a subsidy is introduced in

[3]In the case of scientific publishing, it seems that those who profit the most from copyright are not the originators but the publishers. There are arguments that this is not an exception, but that the introduction of copyrights in general mainly benefits intermediaries and not originators, see Litman (2018).

the second market. In that case, there is perfect competition in the first market (everyone can copy the product), while there is a subsidized monopoly in the second market. The welfare properties of the two different regimes are compared in Section 4. Section 5 concludes.

2 Case 1 (Status Quo) – Both Markets Operating as Monopolies

We introduce two markets with two goods. The first market is the market in which innovation takes place, where works can easily be copied. In the second market copying is not possible. Both markets operate as monopolies (due to the intellectual property rights in the first market, naturally in the second) and no subsidy is provided. We resort to linear equations (also in the subsidy regime) for simplicity.[4]

2.1 First Market – Monopoly

First, consider the structure of the first market, in which the innovation takes place. The market is illustrated graphically in Figure 1. The marginal cost is constant at $c \geq 0$ and is thus represented by a horizontal line. This marginal cost can be thought of as the cost of copying the idea (c may be small, e.g. when copying CDs, or even approximately zero, e.g. when copying mp3 files).

The demand for the innovation product and the marginal revenue are given by the following

[4] In applications to data, it may be easiest to estimate linear equations. The model could also be extended to non-linear equations, but this would make the model less tractable.

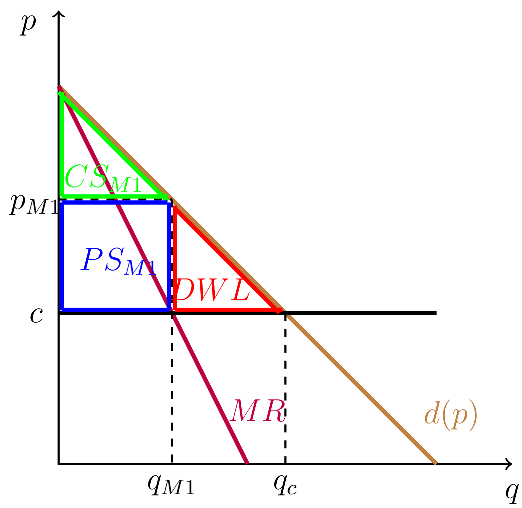

Figure 1: Case 1, market 1: Monopoly with constant marginal cost

equations, with positive parameters ψ and ϕ:[5]

$$D(q) : p = \psi - \phi q$$

$$MR(q) = \psi - 2\phi q.$$

The profit maximizing choice for the innovator/monopolist is to operate where the marginal revenue is equal to marginal cost:

$$\psi - 2\phi q = c$$

$$q_{M1} = \frac{\psi - c}{2\phi}.$$

The price charged by the originator, who acts as monopolist due to the intellectual property rights, can be obtained by entering the monopoly quantity into the equation for the demand curve:

$$p_{M1} = \psi - \phi q_{M1} = \psi - \phi \frac{\psi - c}{2\phi} = \frac{\psi + c}{2}.$$

[5]To be precise, the equation is the equation of the inverse demand curve, as demanded quantity is a function of price. As supply-demand graphs typically are drawn with quantity on the horizontal axis, we will simply refer to these equations as demand equations in the text.

The producer surplus is calculated as the difference between the price and the cost multiplied by the monopoly quantity:

$$PS_{M1} = (p_{M1} - c)q_{M1} = (\frac{\psi + c}{2} - c)(\frac{\psi - c}{2\phi}) = \frac{(\psi - c)^2}{4\phi}.$$

The consumer surplus (the triangle below the demand curve and above the monopoly price p_{M1}) is thus:

$$CS_{M1} = \frac{\psi - p_{M1}}{2} q_{M1} = (\frac{\psi - \frac{\psi + c}{2}}{2})(\frac{\psi - c}{2\phi}) = \frac{(\psi - c)^2}{8\phi}.$$

There is a deadweight loss resulting from the monopoly structure marked as DWL in the graph. It reduces total welfare when compared to perfect competition. Total welfare in this innovation market is thus the sum of the producer surplus and the consumers surplus:

$$TW_{M1} = PS_{M1} + CS_{M1} = \frac{3(\psi - c)^2}{8\phi}.$$

2.2 Second Market – Monopoly

In the second market, the originator also has monopolistic power (however, this time naturally and not due to the assignment of any rights; in the music example, this corresponds to giving concerts) and operates at an increasing marginal cost: in the music example, each additional concert is costly for the artist. This market is illustrated in Figure 2.

The equations for marginal costs, demand, and marginal revenue are:

$$MC(q) = \theta + \epsilon q$$

$$D(q) : p = \gamma - \eta q$$

$$MR(q) = \gamma - 2\eta q.$$

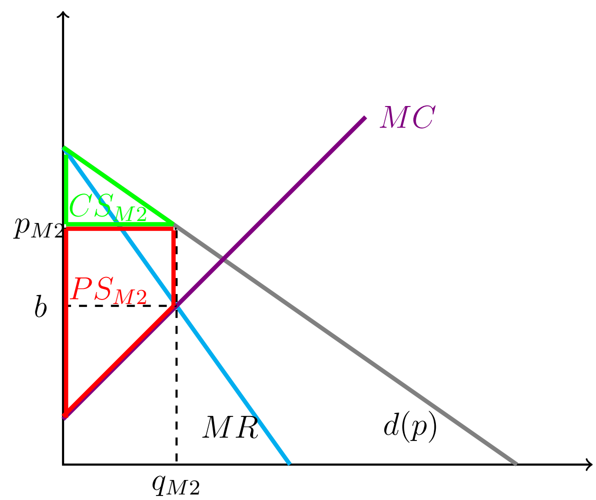

Figure 2: Case 1, market 2: Monopoly with increasing marginal cost

The optimal quantity of production for the monopolist is then as follows:

$$
\begin{aligned}
MC &= MR \\
\theta + \epsilon q_{M2} &= \gamma - 2\eta q_{M2} \\
\epsilon q_{M2} + 2\eta q_{M2} &= \gamma - \theta \\
q_{M2} &= \frac{\gamma - \theta}{\epsilon + 2\eta}.
\end{aligned}
$$

To calculate the producer surplus, the price at which marginal revenue equals marginal cost is needed, which we denote by b:

$$
\begin{aligned}
b &= \gamma - 2\eta q_{M2} \\
b &= \gamma - 2\eta(\frac{\gamma - \theta}{\epsilon + 2\eta}).
\end{aligned}
$$

Furthermore, the price charged by the monopolist is:

$$p_{M2} = \gamma - \eta q_{M2} = \gamma - \eta\frac{\gamma - \theta}{\epsilon + 2\eta}.$$

The consumer surplus (the triangle below the demand curve and above the price p_{M2} is:

$$CS_{M2} = \frac{\gamma - p_{M2}}{2} q_{M2} = \frac{\gamma - (\gamma - \eta * \frac{\gamma-\theta}{\epsilon+2\eta})}{2} (\frac{\gamma - \theta}{\epsilon + 2\eta}).$$

The producer surplus (the area from 0 to the optimum quantity q_M below p_{M2} and above the marginal cost curve) is:

$$\begin{aligned} PS_{M2} &= (p_{M2} - b)q_{M2} + \frac{b - \theta}{2} q_{M2} = q_{M2}(p_{M2} - \frac{b}{2} - \frac{\theta}{2}) \\ &= (\frac{\gamma - \theta}{\epsilon + 2\eta})((\gamma - \eta \frac{\gamma - \theta}{\epsilon + 2\eta}) - \frac{\gamma - 2\eta(\frac{\gamma-\theta}{\epsilon+2\eta})}{2} - \frac{\theta}{2}). \end{aligned}$$

The total welfare for this market is then:

$$TW_{M2} = PS_{M2} + CS_{M2} = (\frac{\gamma - \theta}{\epsilon + 2\eta})(\frac{\gamma + (\gamma - \eta * \frac{\gamma-\theta}{\epsilon+2\eta}) - (\gamma - 2\eta * (\frac{\gamma-\theta}{\epsilon+2\eta})) - \theta}{2}).$$

2.3 Total Welfare of Both Markets in Case 1 (Intellectual Property Protection)

The total welfare arising in both markets jointly is the following:

$$\begin{aligned} TW_{final,M} &= TW_{M1} + TW_{M2} \\ &= \frac{3(\psi - c)^2}{8\phi} + (\frac{\gamma - \theta}{\epsilon + 2\eta})(\frac{\gamma + (\gamma - \eta * \frac{\gamma-\theta}{\epsilon+2\eta}) - (\gamma - 2\eta(\frac{\gamma-\theta}{\epsilon+2\eta})) - \theta}{2}). \end{aligned}$$

3 Case 2 (Subsidy Regime) – Subsidy in the Second Market Instead of Monopoly Rights in the First

In this setting, there is no monopoly in the first market: the first good is produced with a constant marginal cost c and operates in a competitive market (the intellectual property rights have been removed, therefore anyone can copy the good, e.g. the CDs, at constant marginal cost). The second market (with increasing marginal costs) still operates as a monopoly and now receives a government subsidy. The innovator receives the subsidy in the second market as an incentive or compensation, because in the first market with perfect competition there are no profits for the originator.

3.1 First Market – Competition

In first market the innovation takes place. As in the first scenario, the product is produced at a constant cost c and there is no producer surplus as the price of the product is equal to the marginal cost. The market is illustrated graphically in Figure 3.

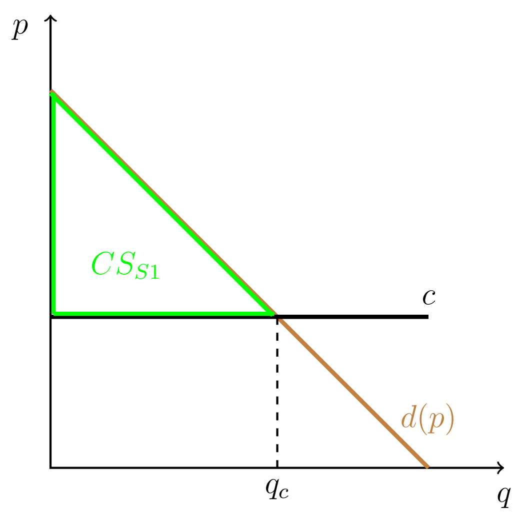

Figure 3: Case 2, market 1: Perfect competition with constant marginal cost

The demand curve is as in the first market in Section 2, the marginal cost is again constant at c:

$$D(q) : p = \psi - \phi q.$$

The quantity produced with perfect competition is:

$$q_c = \frac{\psi - c}{\phi}.$$

The consumer surplus (the triangle below the demand curve and above the constant marginal cost c) is:

$$CS_{S1} = \frac{(\psi - c)}{2} q_c = \frac{(\psi - c)}{2} \frac{(\psi - c)}{\phi} = \frac{(\psi - c)^2}{2\phi}.$$

As there is no producer surplus in this market, the total welfare is equal to the consumer surplus:

$$TW_{S1} = CS_{S1} = \frac{(\psi - c)^2}{2\phi}.$$

3.2 Second Market – Subsidized Monopoly

As in Section 2, there is a monopoly in the second market operating at increasing marginal cost. However, now the originator receives a subsidy from the government. This subsidy takes the form of a fraction m of the price paid by consumers. It can be represented graphically by rotating the demand and marginal revenue curves, as shown in Figure 4. The new demand curve $d(p)_2$ now represents the demand by consumers at a price that already includes the subsidy (a higher quantity is demanded at each subsidy-inclusive price x, because the consumer only pays $x/(1+m)$).

The equations for the marginal cost and for the original demand and marginal revenue curves are as in the second market of the first case in Section 2:

$$MC(q) = \theta + \epsilon q$$

$$D(q)_1 : p = \gamma - \eta q$$

$$MR(q)_1 = \gamma - 2\eta q.$$

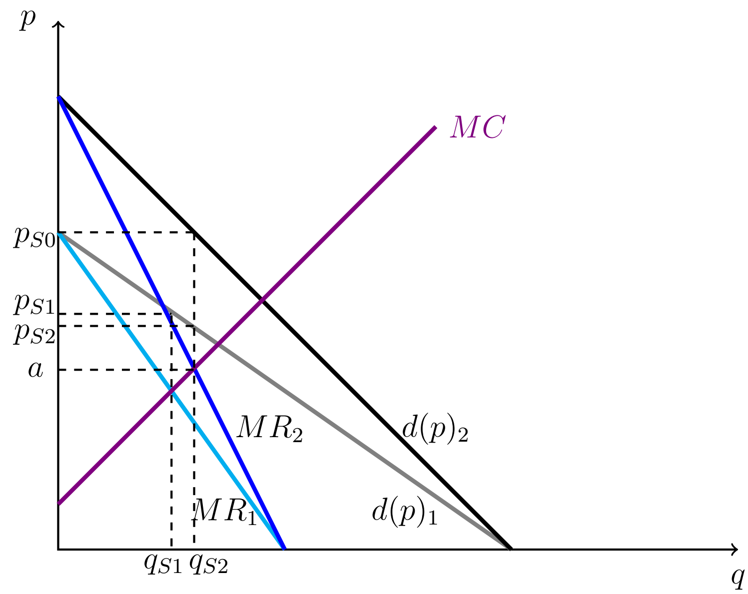

Figure 4: Case 2, market 2, I: Monopoly with increasing marginal cost and subsidy

The demand and marginal revenue curves incorporating the subsidy are:

$$D(q)_2 : p = (\gamma - \eta q)(1 + m)$$
$$MR(q)_2 = (\gamma - 2\eta q)(1 + m).$$

The optimal quantity from the perspective of the monopolist is determined where marginal cost equals the subsidy-inclusive marginal revenue, which is indicated by q_{S2} in Figure 4. The optimal price is the value determined by the demand curve for the respective quantity. It is given by:

$$\theta + \epsilon q = (\gamma - 2\eta q)(1 + m)$$
$$\theta + \epsilon q = \gamma - 2\eta q + m\gamma - 2m\eta q$$
$$\epsilon q + 2\eta q + 2m\eta q = \gamma + m\gamma - \theta$$
$$q_{S2} = \frac{(1 + m)\gamma - \theta}{\epsilon + 2\eta(1 + m)}.$$

The subsidy is paid by the government to the producer. The consumers thus face a price

p_{S2} after the subsidy is introduced, (which is different from p_{S1}, which would have been the price in the market without subsidy), lying on the original demand curve. The price that the originator receives includes the subsidy and thus lies on the subsidy-inclusive demand curve – it is denoted by p_{S0}:

$$p_{S0} = (\gamma - \eta q_{S2})(1+m) = (\gamma - \eta(\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}))(1+m).$$

The price that the consumers are paying is p_{S2} and it is (1 + m) times smaller than the subsidy-inclusive price p_{S0}:

$$p_{S2} = d_1(q_{S2}) = \frac{p_{S0}}{1+m} = \gamma - \eta(\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}).$$

The market including graphical representation of consumer surplus, producer surplus, and paid subsidy is shown in Figure 5. To calculate consumer and producer surpluses, we need the price at the intersection of MC with MR_2, which we denote by a:

$$a = \gamma - 2\eta q_{S2} = \gamma - 2\eta\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}.$$

The consumer surplus (the triangle below the original demand curve and above the price which consumers pay, p_2, is:

$$CS_{S2} = \frac{(\gamma - p_{S2})}{2} q_{S2} = \frac{(\gamma - (\gamma - \eta(\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)})))}{2}(\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}).$$

The producer surplus (the area from 0 to the optimum quantity q_{S2} below p_{S0} and above

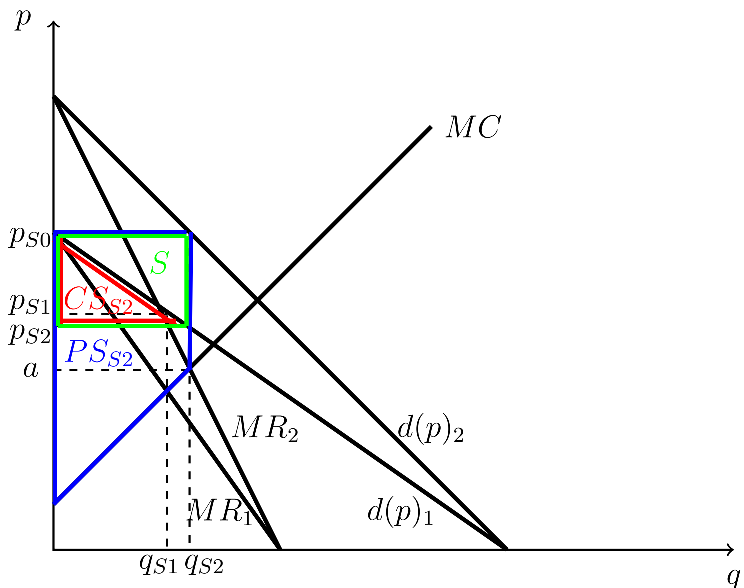

Figure 5: Case 2, market 2, II: Monopoly with increasing marginal cost and subsidy

the MC curve) is:

$$
\begin{aligned}
PS_{S2} &= (p_{S0} - a)q_{S2} + \frac{(a-\theta)}{2}q_{S2} = q_{S2}(p_{S0} - \frac{a}{2} - \frac{\theta}{2}) \\
&= \frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}(((\gamma - \eta(\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}))(1+m)) - \frac{(\gamma - 2\eta\frac{(1+m)\gamma-\theta}{\epsilon+2\eta(1+m)})}{2} - \frac{\theta}{2}).
\end{aligned}
$$

Finally, the government has to pay the subsidy. The total payment by the government is:

$$
S = (p_{S0} - p_{S2})q_{S2} = (mp_{S2})q_{S2} = m(\gamma - \eta(\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}))(\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}).
$$

Therefore, the total welfare in the second market is the sum of the consumer surplus and the producer surplus less the subsidy payment:

$$
\begin{aligned}
TW_{S2} &= CS_{S2} + PS_{S2} - S = q_{S2}(\frac{\gamma + p_{S2} - a - \theta}{2}) \\
&= (\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)})(\frac{\gamma + (\gamma - \eta(\frac{(1+m)\gamma-\theta}{\epsilon+2\eta(1+m)})) - (\gamma - 2\eta\frac{(1+m)\gamma-\theta}{\epsilon+2\eta(1+m)}) - \theta}{2}).
\end{aligned}
$$

3.3 Total Welfare of Both Markets in Case 2 (No Intellectual Property Protection with Subsidy in the Second Market)

The total welfare from both markets jointly is the sum of the total welfare in the first and the total welfare in the second market:

$$
\begin{aligned}
TW_{final,S} &= TW_{S1} + TW_{S2} = \frac{(\psi - c)}{2} q_c + q_{S2}\left(\frac{\gamma + p_{S2} - a - \theta}{2}\right) \\
&= \frac{(\psi - c)^2}{2\phi} + \left(\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}\right)\left(\frac{\gamma + (\gamma - \eta(\frac{(1+m)\gamma-\theta}{\epsilon+2\eta(1+m)})) - (\gamma - 2\eta\frac{(1+m)\gamma-\theta}{\epsilon+2\eta(1+m)}) - \theta}{2}\right).
\end{aligned}
$$

4 Comparison of the Models

In this section we compare the two cases (intellectual property rights in the first market or subsidy in the second market). The formulas are direct consequences of the derivations in the previous sections.

There are two main comparisons. The first comparison regards total social welfare between the two regimes. From the government's perspective, the regime with higher social welfare should be preferred. However, also the comparison of the producer surplus is relevant. If, in addition to social welfare, also the producer surplus is higher in the regime without intellectual property rights but with a subsidy in the second market, then abolishing intellectual property protection while introducing the subsidy would be beneficial not only from a societal point of view, but even from the point of view of the originator.

In applications, which regime and what level of subsidy are best will necessarily depend on the (estimated) parameters. This depends on the slopes of the curves, but also on the levels – if the second market is very small in comparison to the first, it is less likely that the introduction of a (reasonably sized) subsidy can compensate for the loss of intellectual property right protection in the first market (correspondingly, larger secondary markets make it more likely that replacing intellectual property rights in the first market with subsidies in the second is a good idea).

4.1 The Difference in Total Welfare

From the point of view of social welfare, it is desirable to replace intellectual property rights in the first market with a subsidy of size m in the second market if the below difference is positive:

$$TW_{final,S} - TW_{final,M} = \frac{(\psi - c)}{2} q_c + q_{S2}(\frac{\gamma + p_{S2} - a - \theta}{2})$$
$$- (q_{M1}(\frac{\psi + p_{M1}}{2} - c) + q_{M2}(\frac{\gamma + p_{M2} - b - \theta}{2}))$$
$$= \frac{(\psi - c)^2}{2\phi} + (\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)})(\frac{\gamma + (\gamma - \eta(\frac{(1+m)\gamma-\theta}{\epsilon+2\eta(1+m)})) - (\gamma - 2\eta\frac{(1+m)\gamma-\theta}{\epsilon+2\eta(1+m)}) - \theta}{2})$$
$$- \frac{3(\psi - c)^2}{8\phi} - (\frac{\gamma - \theta}{\epsilon + 2\eta})(\frac{\gamma + (\gamma - \eta\frac{\gamma-\theta}{\epsilon+2\eta}) - (\gamma - 2\eta(\frac{\gamma-\theta}{\epsilon+2\eta})) - \theta}{2}).$$

Choosing a value m for the subsidy that maximizes social welfare is interesting from a government's perspective. In applications, this maximization is probably best conducted numerically – the analytical results are quite complex. We derive the first order conditions of such a maximization in a slightly simplified version of the model in the appendix.

4.2 The Difference in Producer Surplus

If not only social welfare is higher in case 2 than in case 1, but also producer surplus, then the switch from intellectual property protection in the first market to subsidy of size m in the second market would even be preferred by the originator. This is the case when the following difference is positive:

$$
\begin{aligned}
PS(2) - PS(1) &= q_{S2}(p_{S0} - \frac{a+\theta}{2}) - (p_{M1} - c)q_{M1} - q_{M2}(p_{M2} - \frac{b+\theta}{2}) \\
&= \frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}(((\gamma - \eta(\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)}))(1+m)) - \frac{\gamma - 2\eta\frac{(1+m)\gamma - \theta}{\epsilon + 2\eta(1+m)} + \theta}{2}) \\
&- \frac{(\psi - c)^2}{4\phi} - (\gamma - \eta(\frac{\gamma - \theta}{\epsilon + 2\eta}) - \frac{\gamma - 2\eta(\frac{\gamma - \theta}{\epsilon + 2\eta}) + \theta}{2})(\frac{\gamma - \theta}{\epsilon + 2\eta}).
\end{aligned}
$$

5 Concluding Remarks

Assigning intellectual property rights means assigning monopoly rights and these automatically come with a welfare loss. Therefore, scholars have long been suggesting to use reward schemes instead of assigning monopoly rights. However, these suggestions have not yet considerably affected actual policy. A reason may be that implementing such theoretically beneficial reward schemes seems to be difficult in practice.

We propose an easy way to implement rewards, which can be done when there is a second market in which originators operate. It can be better for social welfare and even for originators themselves, if there is a subsidy in the second market instead of monopoly rights in the first market. In countries with a high value-added tax, such a subsidy could be introduced particularly easily by granting a reduced or even zero VAT rate in the second market.

Whether or not such a subsidy in the second market can improve upon an intellectual property right assignment in the first market depends on the specifics of these markets. We provide a first simple microeconomic partial equilibrium model to analyze this. Bringing the model to the data is not straightforward and beyond the scope of this short paper: economically simple concepts like demand equations need to be estimated with non-trivial econometric techniques, because they cannot be observed. We believe that the opportunity to exploit dual markets would lead to increases in social welfare in at least some applications. In the case of music (where record sales via CDs and files, plus for-profit streaming, can be considered the first market, while concerts are the second market), the approach seems particularly promising, because for musicians' earnings the market for live music is about three times as important as the records market (DiCola, 2013).

References

Abramowicz, M. (2019). Prize and reward alternatives to intellectual property. In *Research Handbook on the Economics of Intellectual Property Law*. Edward Elgar Publishing.

Bessen, J. and Maskin, E. (2009). Sequential innovation, patents, and imitation. *The RAND Journal of Economics*, 40(4):611–635.

Biasi, B. and Moser, P. (2020). Effects of copyrights on science: Evidence from the WWII book republication program. *American Economic Journal: Microeconomics*. Forthcoming.

Boldrin, M. and Levine, D. K. (2008). *Against Intellectual Monopoly*. Cambridge University Press.

Brunt, L., Lerner, J., and Nicholas, T. (2012). Inducement prizes and innovation. *The Journal of Industrial Economics*, 60(4):657–696.

Chari, V. V., Golosov, M., and Tsyvinski, A. (2012). Prizes and patents: Using market signals to provide incentives for innovations. *Journal of Economic Theory*, 147(2):781–801.

Davis, L. (2004). Intellectual property rights, strategy and policy. *Economics of Innovation and New Technology*, 13(5):399–415.

DiCola, P. (2013). Money from music: Survey evidence on musicians' revenue and lessons about copyright incentives. *Arizona Law Review*, 55:301.

Gandjour, A. and Chernyak, N. (2011). A new prize system for drug innovation. *Health Policy*, 102(2–3):170–177.

Litman, J. (2018). What we don't see when we see copyright as property. *The Cambridge Law Journal*, 77(3):536–558.

Liu, J. (2014). Copyright for blockheads: An empirical study of market incentive and intrinsic motivation. *Columbia Journal of Law & the Arts*, 38:467.

Perrenoud, M. and Bataille, P. (2017). Artist, craftsman, teacher: "being a musician" in france and switzerland. *Popular Music and Society*, 40(5):592–604.

Shavell, S. and Van Ypersele, T. (2001). Rewards versus intellectual property rights. *The Journal of Law and Economics*, 44(2):525–547.

A Appendix: Choosing a Welfare-Maximizing Subsidy

In applications, the optimal subsidy can easily be computed numerically (given a parameter calibration). Here, we derive the first-order conditions analytically for a slightly simplified model with a reduced number of parameters.

A.1 Comparison of the Models with Amended Demand Curves

We simplify the demand curve for the second market by assuming that it is directly linked to the demand curve for the first market. To be precise, the demand curve in the second market is assumed to be the demand curve in the first market shifted by a parameter δ:

$$D(q)_{2,amended} = \delta + \psi - \phi q$$

In this case, the difference in the producer surplus between the two regimes simplifies to:

$$\begin{aligned}
&PS(2) - PS(1) \\
&= \frac{(1+m)(\delta+\psi)-\theta}{\epsilon+2\phi(1+m)}(((\delta+\psi-\phi(\frac{(1+m)(\delta+\psi)-\theta}{\epsilon+2\phi(1+m))})(1+m) - \frac{\delta+\psi-2\phi\frac{(1+m)(\delta+\psi)-\theta}{\epsilon+2\phi(1+m)}+\theta}{2}) \\
&-((\frac{\psi-c}{2})(\frac{\psi-c}{2\phi}) - (\delta+\psi-\phi(\frac{\delta+\psi-\theta}{\epsilon+2\phi}) - \frac{\delta+\psi-2\phi(\frac{\delta+\psi-\theta}{\epsilon+2\phi})+\theta}{2})(\frac{\delta+\psi-\theta}{\epsilon+2\phi}).
\end{aligned}$$

The difference in total welfare between the regimes becomes:

$$\begin{aligned}
&TW_{final,S} - TW_{final,M} = \frac{(\psi-c)^2}{2\phi} \\
&+(\frac{(1+m)(\delta+\psi)-\theta}{\epsilon+2\phi(1+m)})(\frac{(\delta+\psi)+((\delta+\psi)-\phi(\frac{(1+m)(\delta+\psi)-\theta}{\epsilon+2\phi(1+m)})) - ((\delta+\psi)-2\phi\frac{(1+m)(\delta+\psi)-\theta}{\epsilon+2\phi(1+m)})-\theta}{2}) \\
&-\frac{3(\psi-c)^2}{8\phi} \\
&-(\frac{(\delta+\psi)-\theta}{\epsilon+2\phi})(\frac{(\delta+\psi)+((\delta+\psi)-\phi*\frac{(\delta+\psi)-\theta}{\epsilon+2\phi}) - ((\delta+\psi)-2\phi(\frac{(\delta+\psi)-\theta}{\epsilon+2\phi}))-\theta}{2}).
\end{aligned}$$

A.2 Optimal Subsidy

We now derive the first order conditions for the optimal value of m, maximizing the difference between subsidized and non-subsidized markets' total welfare (for the simplified model introduced in Appendix A.1). As the terms without m in this difference drop out when taking the derivative, we concentrate on the term including m and simplify it further:

$$
\begin{aligned}
&(\frac{(1+m)(\delta+\psi)-\theta}{\epsilon+2\phi(1+m)})(\frac{(\delta+\psi)+((\delta+\psi)-\phi(\frac{(1+m)(\delta+\psi)-\theta}{\epsilon+2\phi(1+m)}))-((\delta+\psi)-2\phi\frac{(1+m)(\delta+\psi)-\theta}{\epsilon+2\phi(1+m)})-\theta}{2}) \\
&=(\frac{\delta+\psi-\theta+m\delta+m\psi}{\epsilon+2\phi+2\phi m})(\frac{\delta+\psi+\phi(\frac{\delta+\psi-\theta+m\psi+m\delta}{\epsilon+2\phi(1+m)})-\theta}{2}) \\
&=(\frac{\delta+\psi-\theta+m\delta+m\psi}{\epsilon+2\phi+2\phi m})(\frac{\phi(\delta+\psi+m\delta+m\psi-\theta)+(\delta+\psi-\theta)(\epsilon+2\phi(1+m))}{2(\epsilon+2\phi+2\phi m)}) \\
&=\frac{(\delta+\psi-\theta+m\delta+m\psi)(\delta\epsilon+3\delta\phi+\ 3\delta\phi m+\psi\epsilon+3\phi\psi+3\phi m\psi-\epsilon\theta-3\phi\theta-2\phi m\theta)}{2(\epsilon+2\phi+2\phi m)^2} \\
&=\frac{(\epsilon+3\phi)(\delta^2+\psi^2+\theta^2)+m\phi(3\delta^2+3\psi^2+2\theta^2)+m\phi(6\psi\delta-5\theta\delta-5\theta\psi)+(2\epsilon+6\phi)(\psi\delta-\theta\delta-\theta\psi)}{2(\epsilon+2\phi+2\phi m)^2} \\
&+\frac{m(\epsilon+3\phi)(\delta^2+\psi\delta-\delta\theta+\psi\delta+\psi^2-\psi\theta)+m^2\phi(\delta+\psi)(3\psi+3\delta-2\theta)}{2(\epsilon+2\phi+2\phi m)^2}.
\end{aligned}
$$

We denote the above term by $f(m)=\frac{g(m)}{h(m)}$, where g and h refer to the numerator and the denominator. We use the standard quotient rule to differentiate the above equation with respect to m:

$$f'(m)=\frac{h(m)g'(m)-g(m)h'(m)}{h(m)^2}.$$

This yields:

$h(m) = 2(\epsilon + 2\phi + 2\phi m)^2$

$h'(m) = 4(\epsilon + 2\phi + 2\phi m)2\phi = 8\phi(\epsilon + 2\phi + 2\phi m)$

$h(m)^2 = 4(\epsilon + 2\phi + 2\phi m)^4$

$g(m) = (\epsilon + 3\phi)(\delta^2 + \psi^2 + \theta^2) + m\phi(3\delta^2 + 3\psi^2 + 2\theta^2) + m\phi(6\psi\delta - 5\theta\delta - 5\theta\psi)$

$+ (2\epsilon + 6\phi)(\psi\delta - \theta\delta - \theta\psi) + m(\epsilon + 3\phi)(\delta^2 + \psi\delta - \delta\theta + \psi\delta + \psi^2 - \psi\theta)$

$+ m^2\phi(\delta + \psi)(3\psi + 3\delta - 2\theta)$

$g'(m) = \phi(3\delta^2 + 3\psi^2 + 2\theta^2) + \phi(6\psi\delta - 5\theta\delta - 5\theta\psi) + (\epsilon + 3\phi)(\delta^2 + \psi\delta - \delta\theta + \psi\delta + \psi^2 - \psi\theta)$

$+ 2m\phi(\delta + \psi)(3\psi + 3\delta - 2\theta).$

Setting the derivative equal to zero is equivalent to setting the numerator equal to zero (assuming that the denominator is nonzero):

$$h(m)g'(m) - g(m)h'(m) = 0$$
$$h(m)g'(m) = g(m)h'(m).$$

This gives the following expression:

$$2(\epsilon + 2\phi + 2\phi m)^2[\phi(3\delta^2 + 3\psi^2 + 2\theta^2) + \phi(6\psi\delta - 5\theta\delta - 5\theta\psi)$$
$$+ (\epsilon + 3\phi)(\delta^2 + \psi\delta - \delta\theta + \psi\delta + \psi^2 - \psi\theta) + 2m\phi(\delta + \psi)(3\psi + 3\delta - 2\theta)]$$
$$= [(\epsilon + 3\phi)(\delta^2 + \psi^2 + \theta^2) + m\phi(3\delta^2 + 3\psi^2 + 2\theta^2) + m\phi(6\psi\delta - 5\theta\delta - 5\theta\psi)$$
$$+ (2\epsilon + 6\phi)(\psi\delta - \theta\delta - \theta\psi) + m(\epsilon + 3\phi)(\delta^2 + \psi\delta - \delta\theta + \psi\delta + \psi^2 - \psi\theta)$$
$$+ m^2\phi(\delta + \psi)(3\psi + 3\delta - 2\theta)]8\phi(\epsilon + 2\phi + 2\phi m).$$

Simplifications lead to:

$$
\begin{aligned}
&2m[(\epsilon+2\phi)(\delta+\psi)(3\psi+3\delta-2\theta)+\phi(3\delta^2+3\psi^2+2\theta^2)+\phi(6\psi\delta-5\theta\delta-5\theta\psi)\\
&+(\epsilon+3\phi)(\delta^2+\psi\delta-\delta\theta+\psi\delta+\psi^2-\psi\theta)-2\phi(3\delta^2+3\psi^2+2\theta^2)-2\phi(6\psi\delta-5\theta\delta-5\theta\psi)\\
&-2(\epsilon+3\phi)(\delta^2+\psi\delta-\delta\theta+\psi\delta+\psi^2-\psi\theta)]\\
&=4(\epsilon+3\phi)(\delta^2+\psi^2+\theta^2)+4(2\epsilon+6\phi)(\psi\delta-\theta\delta-\theta\psi)-(\epsilon+2\phi)\\
&*[(3\delta^2+3\psi^2+2\theta^2)+(6\psi\delta-5\theta\delta-5\theta\psi)-\frac{(\epsilon+3\phi)(\delta^2+\psi\delta-\delta\theta+\psi\delta+\psi^2-\psi\theta))}{\phi}].
\end{aligned}
$$

This leads to the expression for m satisfying the first order condition in the optimization problem, which can be expressed as a fraction, $m=\frac{A}{B}$, with:

$$
\begin{aligned}
A&=\epsilon(\delta^2+\psi^2+2\theta^2+2\psi\delta-3\theta\delta-3\theta\phi)+2\phi(3\delta^2+3\psi^2+4\theta^2+6\psi\delta-7\theta\delta-7\theta\psi)\\
&\quad+(\epsilon+2\phi)\frac{(\epsilon+3\phi)(\delta^2+\psi\delta-\delta\theta+\psi\delta+\psi^2-\psi\theta)}{\phi}\\
B&=2[\epsilon(2\delta^2+4\psi\delta-\delta\theta+2\psi^2-\psi\theta)+2\phi(2\theta\delta+2\theta\psi-\theta^2)].
\end{aligned}
$$