Copyright enforcement and quality differentiation on the Internet

Marine Lefort

June 2013

To be presented at the SERCI Annual Congress in Paris

Chaire ParisTech d'Economie des Médias et des Marques

Cerna, MINES ParisTech

Tel. : 33 (1) 40 51 91 72

marine.lefort@mines-paristech.fr

Abstract

Right-holders can differentiate their cultural goods to attract consumers with varying level of willingness to pay. Some Internet intermediaries propose similar choices but without authorization. We present in this paper a simple theoretical model of copyright piracy where a right-holder competes in price with an Internet intermediary, in a leader-follower game. Internet intermediaries provide various products differentiated in quality. We want to study how copyright law is internalized by these actors, and how the choice of quality for legal and illegal offers of audiovisual works on the Internet, changes according to the severity of the law. The main results of our model are used to conduct a numerical simulation assigning specific values to our parameters. In this way, we see how our two main variables (law and quality) are altered.

Keywords: copyright, streaming, commercial piracy, price competition, product quality, tort law

JEL Classification: K13, K42, L15, L86

I- Introduction

The legal offer of audiovisual works, both online - video on demand (VOD), streaming music via Spotify or Deezer, etc. – as well as on other media - CD, DVD, Blu-Ray ... – is subject to competition from Internet intermediaries[1] offering illegal streaming or downloading, i.e. without the consent of the beneficiaries.

On the digital marketplace, this competition is reflected in a segmentation of the offer. The various files, whether legally or illegally provided, may have specific characteristics (audio, image, download speed, and streaming technology[2]) both technical as well as related to the contextual environment of the work itself. Each work is available in different formats incorporating specificities: films or music are sold on physical media, but can also be legally purchased in dematerialized format. In addition, it is possible to buy a single work to which editorial supplements can be added. The idea is to adapt the work to a particular environment - depending on the medium in which it will be viewed or listened to, according to the tastes of the public ... - and encourage positive externalities between various artistic creations. Moreover, the differentiation is temporal since there is a specific timeline to the introduction on the market for legal audiovisual works. Internet intermediaries can benefit from this time constraint, offering audiovisual works in advance.

This segmentation of the offer is coupled to various business models: advertising for free access and/or different types of paid access. The latter can cover subscriptions for unlimited access to the files or time-limited purchases. A file hosted by an intermediary without authorization may be viewed for free in streaming but with a limited viewing time, whereas with a subscription the user may have unlimited access to all stored files with a faster download speed. We call this process commercial piracy. For a legal file, there are also subscriptions that provide access to a certain number of works - VOD by subscription - but the purchase may also be carried out for a given period of time (film in digital format visible for one month from its rental).

Segmentation in offer can be viewed as quality differentiation (called also “editorialization” process), which is a central parameter in this competition framework. Quality reflects physical specificities, supplements and also the availability of different

[1] “Internet intermediaries bring together or facilitate transactions between third parties on the Internet. They give access to, host, transmit and index content, products and services originated by third parties on the Internet or provide Internet-based services to third parties” (OECD, 2011).

[2] Streaming technology is a way to deliver a media with partial storage: end-user can play it before the entire file has been downloaded on his computer.

cultural works (especially movies).

In legal terms, these intermediaries are not responsible a priori for the legality of files they host on their platform: their liability depends on the legal recognition of their status as host and judicial decisions in this field. They are not held liable as long as there is no evidence of their knowledge of the unlawful status of a file[3]. This raises uncertainty in the application of their status. Hence, liability is decided by trial and judge interpretation.

The issue at hand is the following: how, in an environment that values - at the discretion of the judges - the liability of hosting website, is the competition in quality reflected between legal and illegal distribution of audiovisual works? More specifically, what is the relationship between the choice of quality of works offered and the civil liability of intermediaries?

The originality of our approach is to apply tort law to copyright enforcement on the Internet. This application is linked to the hosting status of Internet intermediaries: its responsibility is based[4] on the difference between the host and editor functions. The first stores files belonging to others whereas the second modifies and shapes the media available on their platform. The fact that audiovisual works can be viewed in streaming without the authorization of right-holders puts the accent on intermediaries' responsibility. Hence, they are now sued for their responsibility in the hosting function. Numerous law cases regarding intellectual property rights (brand, copyright….) question this status.

Therefore, the aim of this paper is twofold. First we model competition between legal and illegal offer. Then we examine the efficiency of law enforcement in restricting commercial piracy on the Internet when differentiation in quality is used.

To address this issue, we present first a simple theoretical model of copyright piracy where a right-holder competes in price with an Internet intermediary. Afterwards, by assigning specific values to the quality parameters and penalty, if the intermediary is convicted, the model serves to illustrate how the choice of quality of the legal and illegal files changes according to the severity of the law applied to the intermediary (or the uncertainty of their liability). The aim of these two approaches is to represent this issue more precisely and to highlights some relevant results.

[3] This is defined in the Digital Millenium Copyright Act (1998) in the United States, and the Electronic Commerce Directive (2000) in Europe.

[4] In France, this status is defined in the "Loi pour la Confiance dans l'économie numérique", (Loi n°2004-575) that introduced this distinction.

We consider four types of agent: the consumers, the original owner of the digital good (or the right-holder), the Internet intermediary, and the legal authority represented by a judge.

Copyright holders can sue the intermediary which offer files without authorization.

Internet intermediary offers (and hosts) pirated content (through streaming technology for example) in one of the following two ways (versioning of the good): consumers can benefit from free content but with restrictions (e.g. viewing time, as on Megaupload), or they can buy unlimited access reflecting the segmentation in offer. Several categories among the intermediaries that facilitate streaming can be distinguished[5]:

- Host sites enabling direct download or use of streaming without specific research tools. Some sites provide only one of these two functions
- Referral sites providing links to download files or to watch films in streaming hosted on other platforms.

Internet intermediaries studied in our paper belong to the firt category of websites.

As for Mussa and Rosen (1978), there is a quality differentiation: streaming goods offered by the intermediary could be of lower quality than legal ones. For example, there is a difference between watching DVDs and watching movies directly on the Internet (audio, image, editorial supplement etc.). Hence, quality parameters represent the quality of the files. Furthermore, we have a double quality differentiation since the intermediary offers two distinctive goods.

Consequently, the quality of legal good can change, indicating that the copyright-holder has the possibility of differentiating its own good. The quality of unlimited illegal product is superior to that of goods with restrictions (e.g. no limitation on the contents visualized) but may have the same value that the legal product. The quality initially conferred on the product by the legal distributor can be improved by the differentiation carried out by the legal as well as illegal intermediary: in the case of music, platforms can offer song listening through playlists and a unique visual environment; access to a large number of films or series on illegal platforms can elevate the quality of membership compared to that of authorized distribution. Quality of streaming products can also represents the fact that some audiovisual works are first available through streaming channel and then through legal means. It is the case for some foreign TV series. We choose to study this competition in a leader-follower game in price where quality is exogenous.

[5] "Study of the economic model of sites or streaming services and direct download of illegal content", Report for the attention of the Hadopi, Idate 2012.

We find that pricing and the required level of law enforcement to evict the Internet intermediary are set relative to quality. We demonstrate also with the numerical simulation a link between quality choices and liability of the intermediary: the investment in quality carried out by the latter is correlated to the severity of the law applied to the host.

The paper is structured as follows. Section 2 isa review of related literature and specifies what makes our distinctive framework. In section 3 we present the model and the main variables. Section 4 examines the equilibrium and the influence of legal enforcement on intermediary's decisions. In section 5 we present the numerical simulations and its main results. Conclusions are provided in section 6.

II- Related literature

The main approach is here to apply tort law to Internet intermediaries that offer streaming goods: they can be held liable for infringing intellectual property law. This is a new perspective in literature. As said previously, we focus on the hosting status of such websites. Beginning with Shavell (1984a, 1984b and 1987) and Landes and Posner (1987), literature on tort law allows potential victims to receive compensation, and encourages economic agents to internalize the costs of externalities that their actions could cause. Economics and the law come together in the search for efficient behavior that minimizes the social cost of a potential tort by internalizing this externality.

Numerous rules of liability have been studied, taking into account the liability between victim and injurer (strict liability, negligence rule). This liability can in some cases be shared between parties (contributory and comparative negligence).

In the formalization of such a system, agents take action (called "care") to avoid accidents. Thus, convictions are not systematic and courts make decisions based on their interpretation of social optimum levels of precaution (for negligence rules).

The tort analysis was extended to errors in law operations (Dari-Mattiacci 2005), e.g. in a due care setting. Uncertainty of the legal system makes the issue of conflict resolution difficult to anticipate, as in our present case regarding the liability of intermediaries.

Focusing on copyright law, Arai (2011) compares the implication of civil and criminal penalty schemes (i.e. penalties paid to the copyright holder or the government) from the viewpoint of social welfare in cases of copyright violation. Martínez-Sánchez (2010) analyzes the role of the government and a legal producer in preventing the entry of a pirate in a sequential duopoly model of vertical product differentiation. The latter can

bring the advantage of allowing the pirate to set the price first. Banerjee (2006) studies the effect of enforcement sharing between the government and the incumbent in a commercial piracy framework (the former penalizes and the latter monitors). Government sensitivity to piracy is an important condition to prevent infringement.

Arai's analysis (2011) is more related to our framework since he studies the interaction between copyright holders, copyright infringement and law penalty.

We link tort law to commercial piracy. This is a new approach since not long ago Internet intermediaries were protected by their hosting status. But recently, justice decisions have questioned this position.

Our model tries to capture also competition in quality between an Internet intermediary and a right-holder. Two papers are related to this issue: Banerjee (2003) studies competition between a copyright owner and a pirate who tries to enter the market, and the government's role in penalizing piracy. He finds that if monitoring is the optimal policy, then a monopoly situation results. Kiema (2008) extends this analysis to the competition between a monopolist and several commercial pirates.

III- The model

In this section, we first present the behaviors and parameters for the main actors of our framework and then the demand for legal and illegal offer

III-1- Main actors

Legal protection

Regarding, the legal copyright framework for Internet intermediaries, the court has to decide on the ex-post liability of these websites. We are in a civil law set-up, meaning that there is only a monetary transfer from the copyright infringer to the copyright holder.

The first move is made by the right-holder: after having discovered a pirate or a streaming website offering illegal files, the legal beneficiary can bring the case to court. Then the right-holder can demand financial compensation. Subsequently, the judge has to determine the liability of the Internet intermediary (i.e. was it aware of the infringement?). Due to the uncertainty of law enforcement (e.g. decisions different between cases, between judges, etc.), intermediary is declared responsible and has to pay an exogenous penalty G to the copyright holder with probability q[6], otherwise it is not punished with probability $1-q$. q represents the strength of the copyright law as well as uncertainty in the

[6] $q \in [0,1]$

law enforcement for intermediaries (as we explained in the introduction). q is chosen ex-ante by the law-maker (tort law). The optimal level of q is given by the maximization of social welfare, which is the sum of right-holder profit, Internet intermediary profit and consumer surplus.

Legal offer

We suppose that there is only one monopolist producer of the legal good (or right-holder) with quality a selling them at price p. This can be justified by arguing that cultural goods are sufficiently horizontally differentiated to make the demand independent of the price of other goods in the same category.

Copyright holders have to enforce their right (e.g. notice and take down procedure). They choose an exogenous monitoring intensity e ($e \in [0,1]$), meaning that the illegal file (and the intermediary) is discovered with probability e. The monitoring effort has a cost $c(e)$ that increases with its intensity level.

Assumption 1: $c'(e) > 0$ and $c''(e) > 0$ and e is an exogenous parameter.

In reality, the intensity level varies according to the significance of the legal producer, its resources and its market power. This is true for trademark as well as copyright legislation (e.g. the luxury goods industry spends a lot of money protecting trademarks, and firms monitor auction and shopping websites).

Moreover, we make an extreme assumption in our framework: we suppose that the Internet intermediary is always sued and that there is no private settlement. However, for the most part, going to court is costly for the right-holder.

In practice, the expected penalty is given by eqG. However, the result does not change if we take e and G together since there are both exogenous parameters. Therefore, we suppose that the expected penalty is only qG. The right-holder profit function is:

$$\pi_p = pD_l + qG - c(e) \qquad (1)$$

Where D_l is the demand for the legal product and qG the compensation paid by the copyright infringer if it is discovered and found guilty by the judge. For simplicity, we also suppose that production costs are nil.

Internet intermediary

The Internet intermediary offers illegal streaming i.e. streaming of pirated goods. There is only one Internet intermediary in our framework.

The Internet intermediary has two sources of revenue: the price paid for unlimited content access with quality b, and advertisement[7] revenue normalized to 1 generated by demand for the free version with quality c.

Assumption 2: Here $0 < c < b \leq a \leq 1$

Assumption 2 defines quality for the legal or illegal goods. The fact that b may be equal to a highlights the "editorialization" process of the Internet intermediary.

The Internet intermediary is discovered by the right holder with probability e, it is found liable (and has to pay the fine) with probability q.

The Internet intermediary profit function is:

$$\pi_i = (1-e)(p_i D_u + D_r) + e[(1-q)(p_i D_u + D_r) - qG] = (1-q)(p_i D_u + D_r) - qG \quad (2)$$

Where D_u is the demand for unlimited access and D_r the demand for free access. We choose to not study separately q and e, to simplify the profit. We also suppose reproduction costs to be nil. All the quality choices are defined according to Assumption 1.

III-2- Consumer demand

There is a continuum of consumers indexed by θ who value the digital good differently. θ also represents their willingness to pay and it is uniformly distributed on [0. 1][8].

Consumers have three options: First they can purchase the good legally at price p. Second, they can use it freely on the Internet but with restrictions. Lastly, they can buy unlimited access to the streaming website and its contents at a price p_i . p_i can be seen as a subscription fee. Users do not face the risk of prosecution from the use of streaming websites.

Consumer's utility is defined as follows:

$$U = \begin{cases} a\theta - p \text{ if consumer buys the legal product} \\ b\theta - p_i \text{ if consumer pays to a have unlimited access} \\ c\theta \text{ if consumer uses streaming with restriction} \end{cases}$$

What is the demand for the different goods?

[7] On this type of website, advertisement comes mainly from pop-ups and banners (Idate, 2012, *Etude du modèle économique de sites ou services de streaming et de téléchargement direct de contenus illicites*, Rapport à l'attention de la Hadopi).

[8] We assume that the market is always covered by the legal or the streaming good.

We need to distinguish between different cases depending on the parameters. Moreover, consumers choose products already available on the market.

We take three marginal consumers that are indifferent to two options: θ_{lr} is indifferent to buying the legal product or consuming it freely with restriction, θ_{ru} is indifferent to consuming the free illegal version or paying a fee for unlimited access, θ_{lu} is indifferent to buying the good legally or paying p_i to consume the good without restriction but illegally.

$$a\theta_{lr} - p = c\theta_{lr} \Rightarrow \theta_{lr} = \frac{p}{a-c}$$

$$c\theta_{ru} = b\theta_{ru} - p_i \Rightarrow \theta_{ru} = \frac{p_i}{b-c}$$

$$a\theta_{lu} - p = b\theta_{lu} - p_i \Rightarrow \theta_{lu} = \frac{p - p_i}{a - b}$$

Lemma 1

Given the quality parameters and the strength of intellectual property enforcement, the consumer's optimal choice is to only use simple streaming (streaming with restriction) if

$\theta \leqslant min\ \{\theta_{lr}, \theta_{ru}\}$

A consumer will choose to pay a subscription fee to the Internet intermediary if

$\theta_{ru} < \theta < \theta_{lu}$

A consumer will buy the legal good if

$\theta \geqslant max\ \{\theta_{lr}, \theta_{lu}\}$

Consumer valuation depends on price and quality, and consumers choose goods from among those offered by the right-holder.

From the lemma 1, we can derive price conditions. The consumer will only buy the legal good if it is not too expensive; meaning θ_{lu} cannot be higher than 1, i.e. $p > a - b + p_i$.

On the other hand, the consumer will not pay the price p_i, if it is too high. No users find it profitable to pay p_i if the legal price is low enough. There is no subscription if $\theta_{ru} > \theta_{lu}$ i.e. $p < \frac{p_i(a-c)}{b-c}$.

Thus, there is a demand for the legal good only if its price p is not too high and if unlimited access is too expensive (p_i too high).

Lemma 2

From these conditions, we can derive different demand cases:

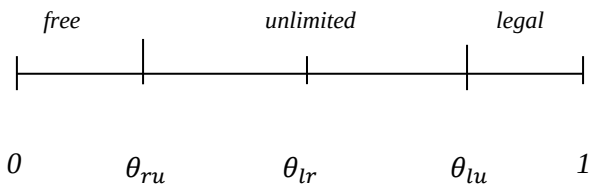
- *Case 1:* $p < a - b + p_i$ *and* $\theta_{lr} < \theta_{lu}$

- *Case 2: no demand for unlimited access when* $p < \frac{p_i(a-c)}{b-c}$
- *Case 3: no demand for the legal good when* $p > a - b + p_i$

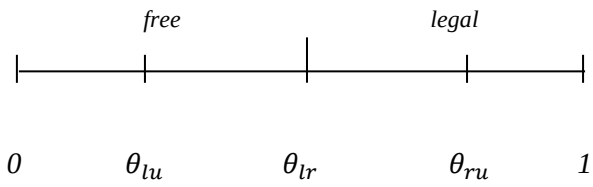
These cases are represented by figure 1.

Figure 1: Demand for the different cases

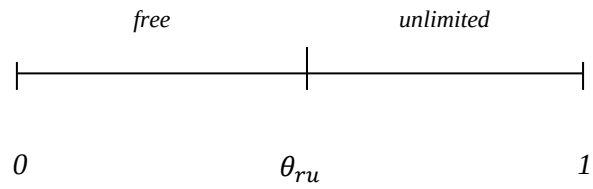
Case 1



Case 2



Case 3



In the next part, we focus only on cases where competition exists between the right holder and the Internet intermediary and where the three goods are offered (cases 1 and 2). We do not study case 3, in which intermediary wins the entire market.

The strategic variables here are prices and the legal strength q. We consider that quality parameters and fine G are exogenous.

The sequence of events is:

1. The government chooses a penalty G and an enforcement level (or law uncertainty) q. The right-holder chooses a monitoring level e (or the probability of the pirate being discovered).
2. The producer and the intermediary compete and choose their prices p_i and p.

3. The consumer decides whether to buy the legal good, use it illegally with restrictions, or pay for unlimited access.
4. Any intermediary who is caught and found guilty has to pay penalty *G*.

The law is constructed ex-ante and the law-maker chooses the severity of the rule. The judge enforces the law ex-post according to his or her interpretation (as in tort law).

IV- Equilibrium characteristics and the impact of quality

In this section, we examine pricing games between the Internet intermediary and the copyright holder for the case 1 and 2 described previously. We consider quality choices (*a, b, c*) as exogenous. We derive the equilibrium prices and equilibrium profits in each situation. We also examine the impact of quality choices.

We are in a leader-follower game: the incumbent takes into consideration that a intermediary will enter and therefore incorporates the reaction function of this agent into its profit function and chooses the profit-maximizing price. The incumbent is the legal developer.

IV-1- Equilibrium for the three goods

IV-1-1-Case 1

The right-holder profit function is now (from Eq. 1):

$$\pi_{p,1} = p(1-\theta_{lu}) + qG - c(e) = p\left(1-\frac{p-p_i}{a-b}\right) + qG - c(e) \qquad (3)$$

The intermediary profit function is (from Eq. 2):

$$\pi_{i,1} = (1-q)(p_i(\theta_{lu}-\theta_{ru}) + \theta_{ru}) - qG = (1-q)\left[p_i\left(\frac{p-p_i}{a-b} - \frac{p_i}{b-c}\right) + \frac{p_i}{b-c}\right] - qG \qquad (4)$$

The result is summarized in proposition 1. The proof is provided in annex 1-1. We must first make the following assumption:

Assumption 1: $2a - c - b > 0$

Proposition 1

The equilibrium prices are (with assumption 1 and assumption 3 to have positive prices):

$$p_1^* = \frac{(a-b)(2(a-c)+1)}{2(2a-c-b)} \text{ and } p_{i,1}^* = \frac{(a-b)}{2(a-c)} + \frac{b-c}{2(a-c)}\left(\frac{(a-b)(2(a-c)+1)}{2(2a-c-b)}\right)$$

Equilibrium profits are:

$$\pi_{p,1}^{*}$$
$$= \left(\frac{(2(a-c)+1)(b+c-2a)+(2a-c-b)(1+4a-4c)}{4(a-c)(2a-c-b)}\right)\left(\frac{(a-b)(2(a-c)+1)}{2(2a-c-b)}\right)$$
$$+ qG - c(e)$$
$$\pi_{i,1}^{*} = (1-q) * \left[\frac{(a-b)}{2(a-c)} + \frac{b-c}{2(a-c)}\left(\frac{(a-b)(2(a-c)+1)}{2(2a-c-b)}\right)\right]\left(\frac{(2a-b-c)+a-b}{2(a-c)(a-b)}\right.$$
$$\left. + \frac{a+b-2c+p(c-b)}{2(a-c)(b-c)}\right) - qG$$

Proof: cf Annex 1-1

We note that the equilibrium prices take into account the quality parameters and quality differences (*a-b* or *a-c*). The legal parameter q has no impact on equilibrium prices but does impact general profits.

IV-1-2- Case 2

Here, there are only two possibilities for the consumer: buying the legal good or using free streaming access. This is because unlimited access is too expensive.

The copyright holder profit function is (from Eq.1):

$$\pi_{p,2} = p(1-\theta_{lr}) + qG - c(e) = p\left(1 - \frac{p}{a-c}\right) + qG - c(e) \qquad (5)$$

The Internet intermediary profit function is (from Eq.2):

$$\pi_{i,2} = (1-q)(\theta_{lr}) - qG = (1-q)\left(\frac{p}{a-c}\right) - qG \qquad (6)$$

The intermediary only earns revenue from advertising because there is no demand for unlimited access at price p_i.

Proposition 2

$$The\ right-holder\ equilibrium\ price\ is:\ p_2^{*} = \frac{a-c}{2}$$

Equilibrium profits are:

$$\pi_{i,2}^{*} = \frac{1-q-2qG}{2}\ and\ \pi_{p,2}^{*} = \frac{a-c}{4} + qG - c(e)$$

Proof: cf Annex1-2

Here the legal parameter q does not influence the intermediary's profit. Moreover, the right-holder and Internet intermediary share the market equally:

$D_{p,2} = 1 - \theta_{lr} = 1/2$

$D_{i,2} = \theta_{lr} = 1/2$

When the Internet intermediary offers only the free streaming good on the market, it cannot fix the price. Its only degree of freedom is quality parameter *c*. This parameter negatively impacts the right-holder's price and therefore its profit. As *c* increases p_2^* goes down. To keep its market, the incumbent has to decrease its price when the intermediary chooses to increase the quality *c*.

At the same time, the intermediary's profit function decreases with q: the Internet intermediary is more likely to be sued and found guilty of damages to the right-holder.

Table 1: Summary of cases (prices)

	p^*	p_i^*
Case 1	$\frac{(a-b)(2(a-c)+1)}{2(2a-c-b)}$	$\frac{(a-b)}{2(a-c)} + \frac{b-c}{2(a-c)}\left(\frac{(a-b)(2(a-c)+1)}{2(2a-c-b)}\right)$
Case 2	$\frac{a-c}{2}$	X

IV-2- Quality and maximum differentiation

After computing the equilibrium prices and profits, we study the impact on piracy of quality choices and quality difference.

We use equilibrium Internet intermediary demands as a measure of piracy[9]. We call θ_{lr}^* and θ_{lu}^* the equilibrium market shares. We examine the effect of *c* on θ_{lr}^* and the effect of b on θ_{lu}^*. If these decrease with intermediary's quality parameters, it means that the intermediary's market share and degree of piracy decrease. On the contrary, if they increase, the intermediary's market share increases and there is more piracy. We study the sign of the derivative of θ_{lr}^* and θ_{lu}^* with respect to *b* or *c* (proof in *Annex 1-3*).

A change in quality parameters affects the market. Intuitively, when the quality of the intermediary's product increases, the right-holder's profits go down. Indeed, to stay on the market, the producer has to lower its price. Therefore, theintermediary's market share and profit increase when *b* or *c* go up.

[9] See Banerjee (2003).

At this point we can make diverse conclusions. As quality parameter *c* goes up, piracy increases meaning that it affects the market. A rise in quality increases demand. Yet surprisingly, when *b* increases, there is no effect on piracy:

$$\frac{\delta \theta^*_{lu}}{\delta b} = 0$$

In this case, the intermediary's market share of unlimited access does not change. When *b* goes up, quality of unlimited streaming good rises to the level of the legal good and it may be worthwhile for the consumer to buy the legal good instead of the streaming one. The positive demand for the unlimited streaming good on the market may only come from its unlimited characteristic. For the Internet intermediary, increasing the quality of its goods does not always guarantee greater market power.

For case 2, we show through Proposition 2 that the monopolist price is a decreasing function of *c*. This is consistent with our previous argument: to stay on the market, the right-holder has to decrease its prices when intermediary quality increases. However, an increase in *c* does not change market shares because demand is constant in that case.

Is it worthwhile for the right-holder and the Internet intermediary to maximize the quality parameter differentiation? For fixed prices in case 1, we study the impact of quality differences, *a*-*b*, on profits: if the difference between *a*-*b* increases, it means that the quality difference increases (i.e. the legal good is of better quality and the streaming good of lower quality). We find two results. Proof is given in *Annex 1-4*.

First, if $p_i < p$ the right-holder benefits from the low quality of the Internet intermediary, its profit increases, but the latter does not benefit from the high quality of the legal good. Since the intermediary's price is lower than the right-holder's price, increasing the quality of the legal good compared to the streaming good is a way of attracting consumers that are more sensitive to quality. In addition, competitive pressure can be translated into quality differences. The right-holder appropriates profit indirectly, through rising quality (and if the Internet intermediary chooses a lower level of quality).

Moreover if $p_i > p$, the result is the opposite: the incumbent does not benefit from the low quality of the Internet intermediary since his price is already below the intermediary's price.

These two conclusions show that maximum quality differentiation is not always beneficial for these two agents. In this case, this may be due to the fact that price competition prevails over quality competition.

For case 2, increasing the difference between *a* and *b* increases copyright-holder profit but decreases streaming website profit. Indeed, when *b* tends towards zero, the utility of unlimited streaming goods also tends towards zero and the intermediary's profit goes

down. In this case, it cannot choose its prices. Therefore, it can only use quality parameters to attract consumers.

IV-3- Intermediary's decision

In this section we study which conditions of legal strength (or legal uncertainty) will evict the Internet intermediary from the market.

The Internet intermediary will remain in the market as long as he can make a profit, which puts a limitation on q. For the different cases, we equate its profit to zero and we find the level of q, called $\tilde{q}$, which deters its entry.

This level results from a policy and legal decision. The higher q is, the higher the probability that the intermediary will be caught and stop its activity.

We compute the $\tilde{q}$ which prevents the entry of the. $\tilde{q}$ is the maximum probability (or legal strength) that allows the intermediary to remain in business. If $q \geq \tilde{q}$, it leaves the market.

Proposition 3

Case 1

We introduce $\beta(p^*_{m,lf}, p^*_{i,lf})$ which represents the equilibrium demand for the streaming good ($p_i D_u + D_r$), in the case 1:

$$\beta(p^*, p^*_{i,}) = \left[p^*_i \left(\frac{p^* - p^*_i}{a-b} - \frac{p^*_i}{b-c}\right) + \frac{p^*_i}{b-c}\right]$$

From Proposition 1 we know that $\beta(p^*_m, p^*_{i,})$ is positive.

$\pi^*_{i,lf} = 0$ *means:*

$$\tilde{q}_1 = \frac{\beta}{(\beta + G)}$$

Case 2

$\pi^*_{i,2} = 0$ *means:*

$$\tilde{q}_2 = \frac{1}{(1 + 2G)}$$

Proof: cf Annex 2-1

When the fine G goes up, the level of legal enforcement necessary to evict the intermediary from the market decreases. This is due to the fact that when G goes up, the loss expected is more significant for the intermediary.

We note that $\tilde{q}_2$ is independent of quality, whereas $\tilde{q}_1$ is dependent on these parameters. From Proposition 2, we know that in case 2 the intermediary's profit is independent of the quality choices. Moreover, demand is fixed, thus it is not necessary to take quality into account to deter it. This explains why $\tilde{q}_2$ depends only on G.

We examine the impact of quality differences on $\tilde{q}_1$. $\tilde{q}_1$ is an increasing function of β. And β increases with quality difference (a-b) if $p_i > p$. We provide evidence in *Annex 2-2*.

In this case, higher quality difference implies higher q to evict the Internet intermediary. As we have shown in section IV, if $p_i > p$, the Internet intermediary benefits from a higher quality difference a-b. Its profit increases with a-b and thus q has to be higher to deter its entry.

From section V we also know that piracy increases when intermediary quality parameters go up. Subsequently $\tilde{q}_1$ has to be higher to evict the intermediary from the market if it chooses to increase the quality of streaming goods[10].

In conclusion, we point out that an efficient level of q is contingent to quality parameters and fine G.

V- Simulation

After having described the competition and the quality differentiation in the previous section, in the following part we conduct a numerical simulation. The issue in question is the following: if the quality parameters change, how should the law change to be dissuasive enough to the intermediary?

V-1- Definition of parameters

We decide here to give to our main parameters some particular values to study how the equilibrium is altered with quality and law penalty. We focus only on case 1, where the three different products are in the market. In other words, we study how the law enforcement (or the granting of the hosting status),$\tilde{q}_1$, changes according to the exogenous parameters (quality and fine). $\tilde{q}_1$ is the minimum level to evict the intermediary from the market. Therefore it is our law parameter for this numerical simulation.

The quality of each file is defined by an independent parameter. In light of what exists on the Internet, there are three categories in the choice of quality (or "editorialization") of the legal distributor, whether by the Internet or other media. Accordingly, the quality may be

[10] This is consistent with Banerjee (2003): he finds that increasing the quality parameter increases the government's optimal monitoring rate (to have a monopoly situation).

linked:

- To editorial extras: bonus, metadata, contextual device on the work, Spotify applications, playlists, links, dubbing, subtitles;
- To the "liberality of use": limited period purchase, VOD subscription with various conditions;
- To access modes: cinema, DVD, Blu-ray, VOD, downloads, remote server storage…

These various features can be combined to form a unique contextual assembly.

Certainly, both players try to attract consumers to maximize their profits and capture the various user preferences. Accordingly, the quality chosen by the legal distributor can be lower or higher than the one chosen by the unauthorized intermediary, whether they offer legal or illegal files. We give to quality parameter, of legal and illegal offer, a value between 0 and 1, according to Assumption 1. The simulation whose results are presented in part IV, demonstrates that the challenge to the intermediary and the severity of the law against them are related to quality parameters respectively chosen by the legal distributor and their unauthorized competitor. Overall, the more a host *editorializes* illegal files the more they risk having their status challenged.

The full law penalty is modeled by two separate parameters: q, the severity or the uncertainty of the law and G the fine (or money transfer between the intermediary who offers illegal files and the legal beneficiary). It can therefore be written in the form qG, where q is the probability of being liable whereas G is an exogenous parameter, based on various case law findings.

It is difficult to put a value on G: the penalty depends on the judge's decision. However, we can assume that G can be defined as a share of income that the intermediaries may receive (through advertising, subscriptions, commissions…):

$G = \delta * revenue$ with $\delta \geqslant 1$

Certainly, the compensation to be paid by the Internet intermediary who supplied the illegal files depends on the traffic it generated, its size and the number of files posted without permission. All these components can be approximated by their income or a part of their income.

To calibrate G, we must rely on two sources. First of all, we use data from IDATE[11], which has calculated the average income perceived by various streaming and hosting sites.

The average income in thousands of euros for these players (medium-sized) are respectively 10 for referencing sites; 100 for downloading sites and 200 for intermediaries of streaming only sites (the high and low range average). This gives an estimate of their

[11] "Study of the economic model of websites or streaming and direct downloading services of illegal contents", Report for the attention of the Hadopi, Idate 2012

size and therefore damages they may have to pay.

We also refer to case law decisions relating to the liability of hosts in the infringement of intellectual property in the general sense: copyright and trademark law. The conclusions in relation to host status and their liability are variable, because, depending on the case, the liability of monitoring may be left to the host themselves or the beneficiary. Here we simply present the case where the intermediary responsible for online posting (a spectator filming in a cinema, for example), has been implicated and sentenced to pay a fine. We expose a limited number of examples to give an overview of the situation (presented in Annex 3).

According to these two sources, it appears that δ is variable, it depends on the reputation of the intermediary and the seriousness of the offense: eBay has been fined several million euros to be paid to L'Oreal, against fines of some thousands of euros for cases of online videos. We choose to adopt G, given the different examples of case law, the following values (in thousands of euros): $G = 10$, $G = 100$, $G = 200$. This is justified by the fact that our study focuses on the intermediaries of streaming and illegal file hosting (non-comparable to companies like eBay).

We are particularly interested in the severity of the law (modeled by the parameter q), which represents the probability of the accusation of unauthorized intermediaries. We can assume that q is effective when the threat leads to the expectation of zero profit for the intermediary and their exit from the market. Accordingly, we have focused on the level of efficiency required for the intermediary to cease their activity, according to the choice of "editorialization" of the legal distributor and the non-approved intermediary. It reflects the accountability of intermediaries and the effectiveness of copyright law in terms of market behavior and monetary incentive. Hence, we will analyze the evolution of $\tilde{q}_1$, according to G and the "editorialization" parameters, a, b, and c. $\tilde{q}_1$ is our main variable, and the others are exogenous parameters: we are interested in analyzing the evolution of q according to quality for different values of G.

We present in the following section our results of the simulation for some values of the parameters.

V-2- Results

Here we analyze the evolution of the degree of liability of the intermediary according to the various model parameters (quality and monetary sanction). Certainly, the link between the sanction (damages) and the quality parameters is carried out through the law. We will focus on the choice of quality for paid alternatives, (a and b), the quality of the free property (c) being conditional on the choice made for an illegal fee-paying file (b).

When relationships are identifiable we present them graphically. The value assigned to q ($\tilde{q}_1$ here), may be interpreted as the expected law strength, that is to say the grant of the hosting status to Internet intermediaries: a high value means less certainty of obtaining host status.

V-2-1- Method

We have seen that the liability is linked to the legal distributor's profit, to the streaming intermediary, as well as consumer demand. Accordingly, we will only consider the situations that lead to a price and a positive demand (as *a, b, c*). Certainly, for some values of parameters of quality, it is not possible to establish results as the demand and prices obtained at model balance are negative. We use the "law enforcement" parameter equilibrium found in Proposition 3 for case 1, since it represents the minimum value to deter the illegal intermediary entry. In the theoretical model, for the demand for the illicit intermediary and the equilibrium price to be positive, the quality of the legal work must be greater than the illegal files. In reality, as mentioned above, the reverse is possible. Hence, in this section, we will consider both cases: $a \leq b$ and $a \geq b$. With this assumption we want be more realistic even if it is different from the one made in the previously.

V-2-2- The importance of the quality of the illegal file (b)

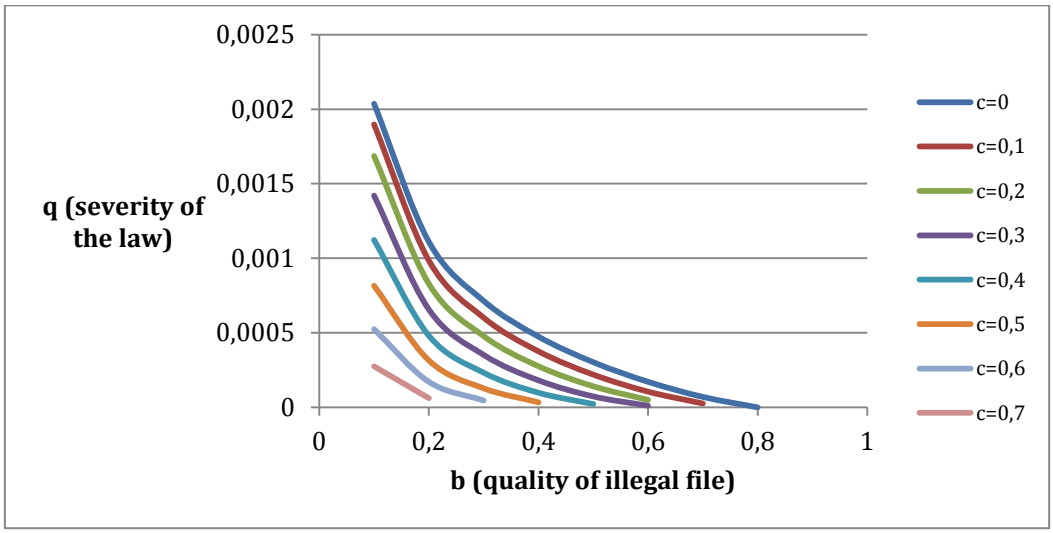
Here we look at the relationship between the choice of quality of the intermediary of illicit files and effectiveness of the law: in what condition is it of interest to the intermediary to remain in the market and compete with the legal distributor? The stricter the law the less the intermediary invests in quality. Certainly, the more they are likely to be held liable, the less they will spend on the "editorialization" of illegal files. Conversely, if the intermediary invests little in quality, the law should be stricter leading them to suspend their activity.

Figure 1 (for a penalty G = 100) describes the decreasing relationship between the severity of the law and the quality of the illegal file, as long as it is less than the quality of the legal product (fixed equal to 1).

The relationship is still the same if the penalty is G = 10 (see Annex 3) or G = 200.

If we choose to give a value inferior to 1 to the legal quality (a = 0.8 or a = 0.5), no clear relationship appears. Certainly, we need to have a positive price and demand for the legal as well as illegal work. When the legal quality is lower than that proposed by the intermediary, the law is effective for isolated quality values and no clear relationship is identifiable (relating to price issue and negative demand).

Figure 1: Severity of the required law to deter the intermediary (q) according to the quality of the illegal file (b) for a quality of a given free (c) file (G=100, a=1)

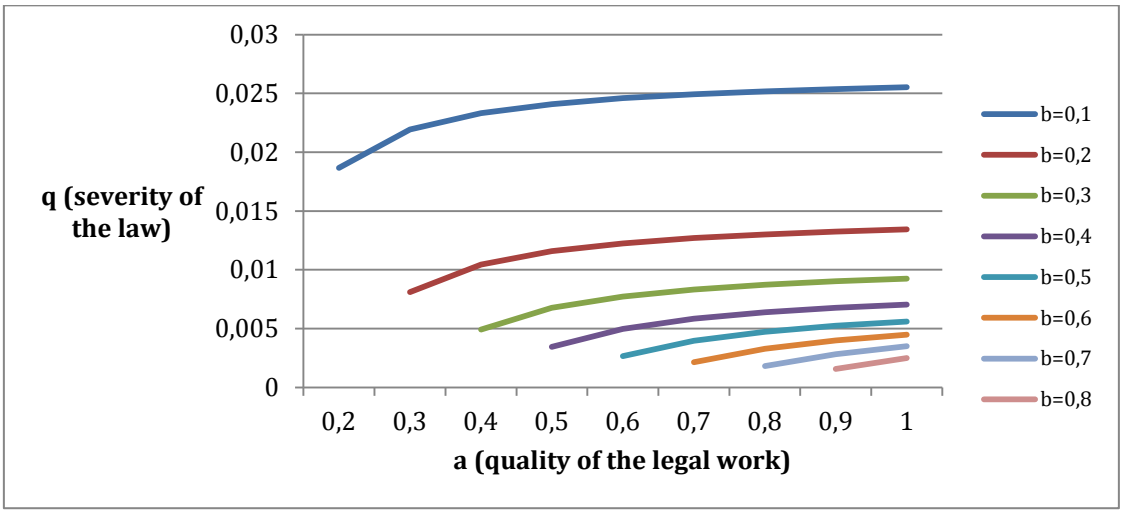


V-2-3- Importance of the quality of the legal work (a)

Let us now turn to the link between the severity of the law against the Internet intermediary and the quality of the legal property. There is a growing relationship between these two variables. The greater the investment in "editorialization" by the legal distributor, the more the law must be severe against the intermediary to deter him from the market. Certainly, if the legal quality increases, the intermediary is distinguished by a lesser quality, which protects them better from the legal risk. In addition, the stricter the law vis-à-vis the intermediary, the more protected the legal distributor is from competition and the more interest they have in contextualizing their products. This relationship is illustrated in Figure 2. If the quality of the free product is zero (c = 0), the severity of the law required to deter the complacent intermediary increases with the quality of the legal distribution (see Figure 2).

This relationship is verified for different values of c (c = 0.1 in particular, see Appendix), always on condition of positive demand. The stricter the law, the less the relationship is clear. The relationship does not change if the monetary penalty is increased from G=100 to G=200 or G=10.

Figure 2: Severity required to deter the intermediary (q) depending on the quality of the legal work (a) for a given quality of illicit file (b) (c=0 and G=100)



V-2-4- Quality difference between the legal work and the illegal file

Here we study the influence of the quality differential between the legal work and the illegal file (available free or not) on the expected severity of the law. This is link to the theoretical analysis conducted in part IV-2, where we analyze the effect of quality differentiation on profits. There are two different relations (represented by Figures 3 and 4):

- The required severity increases with the difference in quality between the legal and illegal property (*a*-*b*): the more the legal and illegal products are differentiated, the more the law must be severe to deter the intermediary. Or conversely, the stricter the law the more the quality differential is important. Not surprisingly, a more stringent law benefits the legal distributor who can increase the quality offered.
- The required severity decreases with the quality difference between the legal property and the free illegal property (*a*-*c*): the wider this is, the less strict the law must be to oust the illegal offer. If the quality of the free illegal file (*c*) is low, the intermediary will have less demand and consequently less revenue. Accordingly, it will be more difficult to compete with the legal distributor and they will be more inclined to suspend their activity.

Figure 3: Severity required to deter the complacent intermediary (q) according to the difference in quality (a-b) for a given quality of free file (c) (G = 100 and a=1)

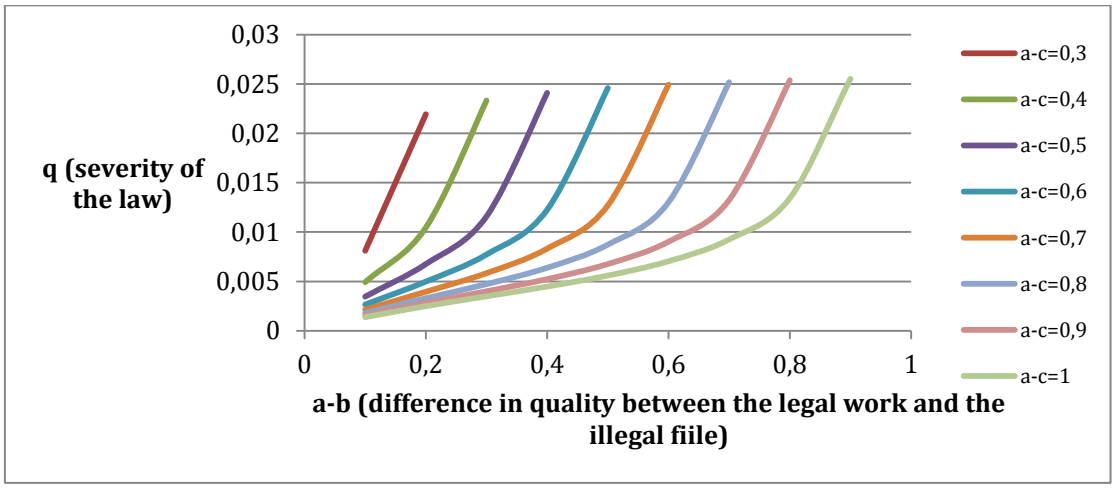
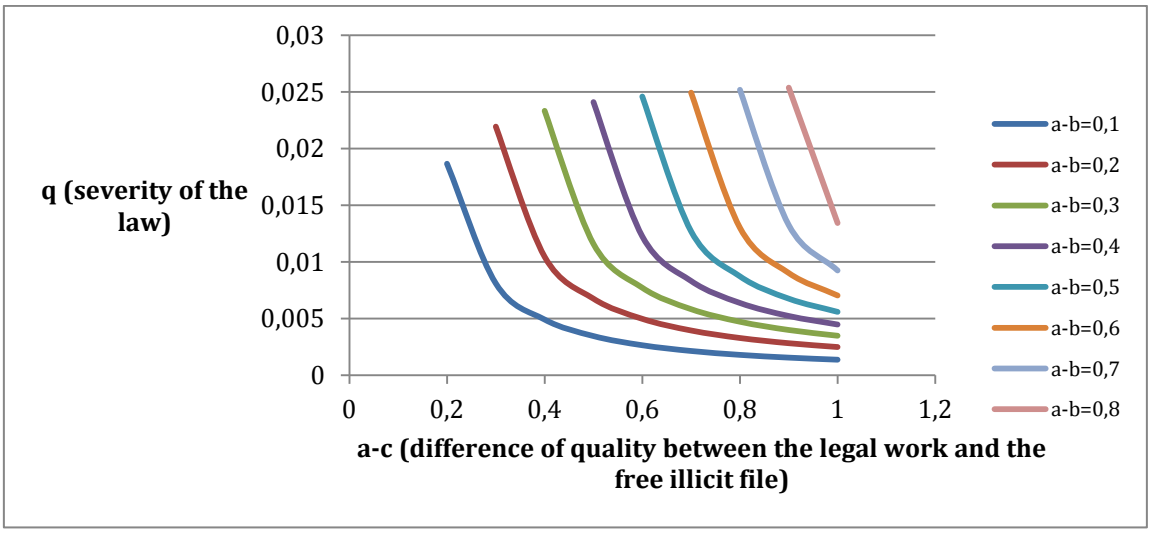


Figure 4: Severity required to deter the complacent intermediary (q) according to the difference in quality (a-c) for a given quality of illegal file (b) (G = 100 and a=1)



These three relationships show the influence of "editorialization" and competition between the legal distributor and the internet intermediary on the expected effectiveness of the law and its uncertainty. Relations do not change regardless of the damages and interest paid by the intermediary (G = 10, *G* = 100 or *G*=200).

VI- Conclusions

This paper explores the strategic behavior of a copyright-holder and an Internet intermediary. The later offers two types of goods, one of which is restricted and one which is not. We model a situation involving only ex-post adjudication. This situation leads to

uncertain enforcement. It corresponds to the concept of a "safe harbor" for Internet intermediaries.

First, we show that right-holder prices take into account Internet intermediary quality choices. Moreover, increasing quality parameters of illegal streaming products can in some cases increase the Internet intermediary's market share. The uncertainty of the law plays also a decisive role in a intermediary's profit and its decision to enter the market.

Secondly, the numerical simulation has shown a relation between quality and law enforcement or law uncertainty: the more restrictive is the granting of the hosting status, the lower is the investment in quality by the intermediary. Furthermore, the more the legal and illegal products are differentiated for paid access, the more the law must be severe to deter the intermediary. This is can explained by the fact that the intermediary will benefit from this differentiation. Regarding the impact on profit, we have found in the theoretical part that right-holder can benefit from a maximum quality differentiation under some conditions on prices.

These results have policy implications for copyright rules and innovation in the field of legal content supplied on the Internet. We have shown that the required enforcement level that reduces intermediary profit to zero, is a function of the version strategies chosen by the Internet intermediary and the right-holder. Conversely, right-holders and Internet intermediaries have to appropriate current legislation. Furthermore, the extent and cost of private monitoring raise real issues regarding the efficiency of legal procedures.

We consider possible avenues for extending our results. In our model we studied legal enforcement's sensitivity to quality parameters. However, for a more general representation, we could extend this sensitivity analysis to private enforcement (i.e. monitoring). Moreover, some assumptions could be revised to extend our model: endogenous quality, other tort law rules (like strict liability), separation between legal and private enforcement (by right-holders) and monitoring.

References

Ahn B-H., and Cho W-Y., (2010), "Versioning of Information Goods under the Threat of Piracy", Information Economics and Policy 22

Alvisi, M., Argentesi, E., and Carbonara, E. (2002), "Piracy and Quality Choice in Monopolistic Markets," Mimeo

Arai Y., (2011), "Civil and Criminal Penalties for Copyright Infringement", Information Economics and Policy 23

Bae S.-H., and Choi, J.P., (2006), "A model of piracy", Information Economics and Policy 18

Banerjee D., (2003), "Software piracy: a strategic analysis and policy instruments", International Journal of Industrial Organization, 21

Banerjee D.S., (2006), "Enforcement sharing and commercial piracy", Review of Economic Research on Copyright Issues 3(1)

Belleflamme P., and Peitz M., (2010), "Digital piracy: Theory" in: Peitz, M. and Waldfogel, J., *Oxford Handbook of the Digital Economy*, Oxford University Press

Bomsel O., and Ranaivoson H., (2009), "Decreasing copyright enforcement costs: The scope of a graduated response", Review of Economic Research on Copyright Issues 6(2)

Chen Y., and Png I., (2003) "Information goods pricing and copyright enforcement: Welfare analysis", Information Systems Research, 14

Conner, K.R., and Rumelt, R.P., (1991), "Software piracy – An Analysis of Protection Strategies", Management Science 37

Cremer H., and Pestieau, P., (2009), "Piracy prevention and the pricing of information goods", Information Economics and Policy 21

Dari-Mattiacci, G., and Parisi F., (2006), "The Economics of Tort Law: A Précis", *The Elgar Companion to Law and Economics* (2nd ed.), Edward Elgar Publishing, 2006

Dari-Mattiacci, G., (2005), "Errors and the Functioning of Tort Liability", Supreme Court Economic Review, Vol.13

Kiema I., (2008), "Commercial Piracy and Intellectual Property Policy", Journal of Economic Behavior and Organization

Landes, W. M., and Posner, R. A., (1987), *The Economic Structure of Tort Law*, Cambridge (MA), Harvard University Press

López-Cuñat J.M., and Martínez-Sánchez F., (2011), "Anti-piracy and quality differential in markets for information goods", Working paper-ad

Martínez-Sánchez F., (2010), "Avoiding commercial piracy", Information Economics and Policy 22

Novos, I.E., and Waldman M., (1984), "The Effects of Increased Copyright Protection:An Analytic Approach," Journal of Political Economy 92

OECD, "The Role of Internet Intermediaries in Advancing Public Policy Objectives", (2011), OECD Publishing

Peitz M., and Waelbroeck P., (2006) "Piracy of digital products: a critical review of the theoretical literature", Information Economics and Policy18.

Poddar S., (2006), "Music Product as a Durable Good and Online Piracy", Review of Economic Research on Copyright Issues, vol. 3(2)

Shavell S., (1984a), "Liability for Harm Versus Regulation for Safety", Journal of Legal Studies 13

Shavell S., (1984b), "A Model for Optimal Use of Liability and Safety Regulation", Rand Journal of Economics 15

Shavell S., (1987), *Economic Analysis of Accident Law*, Cambridge (MA), Harvard University Press

Varian H.R., (2005), "Copying and Copyright", Journal of Economic Perspectives, 19(2)

Yao J.-T., (2005), "Counterfeiting and an optimal monitoring policy", European Journal of Law and Economics 19

Yoon K., (2002), "The Optimal Level of Copyright Protection", Information Economics and Policy, 14

Annex 1

Annex 1-1: Proposition 1-Case 1

The intermediary reaction function is:

$$p_i(p) = \frac{p(b-c)}{2(a-c)} + \frac{a-b}{2(a-c)}$$

We substitute the reaction function of the Internet intermediary into the right-holder profit functions (Eq. 2) and obtain the optimal prices.

These are maximum prices since:

$$\frac{\delta^2 \pi_{p,1}}{\delta^2 p} = \frac{c+b-2a}{(a-c)(a-b)} < 0 \text{ because } c+b-2a<0 \text{ and } 0 \leqslant c \leqslant b<a \leqslant 1$$

$$\frac{\delta^2 \pi_{i,1}}{\delta^2 p} = \left(-\frac{2}{a-b} - \frac{2}{b-c}\right) * (1-q) < 0$$

Annex 1-2: Proposition 1-Case 2

$$\frac{\delta \pi_{p,2}}{\delta p} = \left(1 - \frac{p}{a-c}\right) - \frac{p}{a-c} = 0 \text{ and } p^* = \frac{a-c}{2}$$

This is a maximum since:

$$\frac{\delta^2 \pi_{p,2}}{\delta^2 p} = -\frac{2p}{a-c} < 0$$

Annex 1-3: Quality impact on privacy

We study the sign of the derivative of θ^*_{lr} with respect to c and θ^*_{lu} with respect to b.

$$\theta^*_{lr} = \frac{p^*}{a-c} = \frac{(3-2k)(1-\alpha)}{2(2-k-\alpha)(1-k)}$$

$$\frac{\delta \theta^*_{lr}}{\delta c} = \frac{a-b}{2} * \frac{(2a^2+2c^2-4ac+3a-2c-b)}{[(2a-c-b)(a-c)]^2}$$

$$\frac{\delta \theta^*_{lr}}{\delta c} > 0 \text{ because } 0 \leqslant c \leqslant b<a \leqslant 1 \text{ and } (2a^2+2c^2-4ac+3a-2c-b) > 0$$

$$\theta^*_{lu} = \frac{p^* - p^*_i}{a-b} = \frac{2(a-c)+1}{2(2a-c-b)} * \left(1 - \frac{b-c}{2(a-c)}\right) - \frac{1}{2(a-c)}$$

$$\frac{\delta \theta^*_{lu}}{\delta b} = \frac{2(a-c)+1}{2(2a-c-b)} * \left(\frac{1}{(2a-c-b)} - \frac{b-c}{2(a-c)(2a-c-b)} - \frac{1}{2(a-c)}\right) = 0$$

Annex 1-4: Quality differentiation

Case 1

$$\frac{\delta\pi_{p,1}(p,p_i)}{\delta(a-b)} = \frac{p(p-p_i)}{(a-b)^2} \text{ and } \frac{\delta\pi_p(p,p_i)}{\delta(a-b)} > 0 \; if \; (p-p_i) > 0$$

$$\frac{\delta\pi_{i,1}(p,p_i)}{\delta(a-b)} = -\frac{p_i(p-p_i)}{(a-b)^2} * (1-q) \text{ and } \frac{\delta\pi_i(p,p_i)}{\delta(a-b)} < 0 \; if \; (p-p_i) > 0$$

Case 2

$$\frac{\delta\pi_{p,2}(p,p_i)}{\delta(a-b)} = \frac{p^2}{(a-b)^2} > 0$$

$$\frac{\delta\pi_{i,2}(p,p_i)}{\delta(a-b)} = -\frac{p}{(a-b)^2} * (1-q) < 0$$

Annex 2

Annex 2-1: Proposition 3

To find the level $\tilde{q}$ for the three different cases, we equalize $\pi_i^* = 0$.

For case 1: $\pi_i^* = (1-q) * \beta\left(p^*, p_{i,}^*\right) - qG = 0$

For case 2: $\pi_i^* = \frac{1-q-2qG}{2} = 0$

Annex 2-2: Effect of quality difference on $\tilde{q}_1$

$$\frac{\delta\tilde{q}_1}{\delta\beta} = \frac{G}{(\beta+G)^2} > 0$$

And from section V-2, we know that if $p_i > p$ the intermediary's profit increases with the quality difference (a-b). Thus β increases with quality difference and $\tilde{q}_1$.

Annex 3

Figure 3-1: Severity required to deter complacent intermediary (q) according to the quality of the illegal file (b) for a given quality of free illegal file (c) (G=10 and a=1)

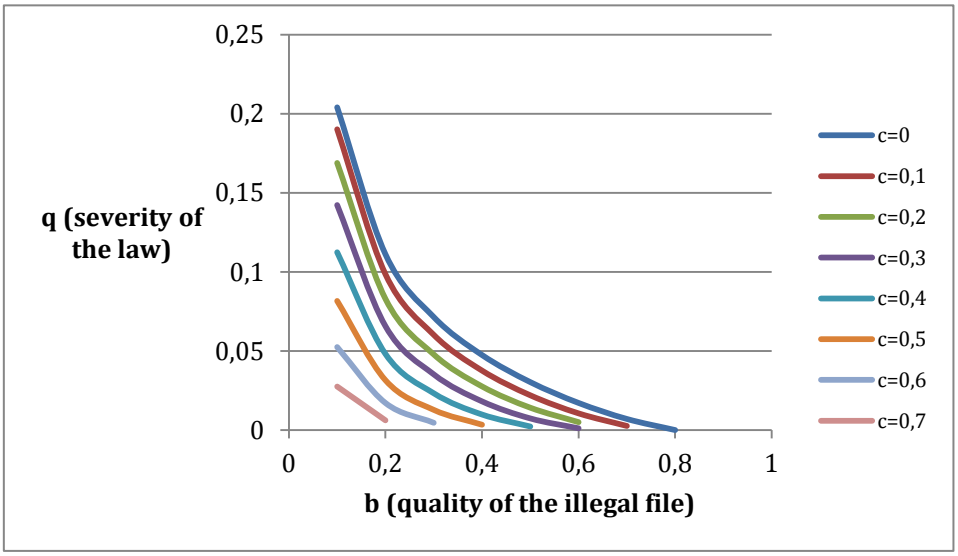


Figure 3-2: Severity required to deter the complacent intermediary (q) according to the quality of the legal property (a) for a given quality of illicit file (b) (c = 0.1 and G=100)