Contracts and Digital Content

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1. Introduction

Copyright law goes back to the time of the U.S. constitution and it is regarded as an important cornerstone of successful intellectual property protection. However, recently it has been criticised strongly. Particularly its extensions to now over 100 years granted by U.S. Congress are widely seen as simply bad policy that misses out on the original intention of promoting the "progress of science and of useful arts" by granting a temporary monopoly.
Moreover, modern information and communication technology makes it increasingly difficult to actually protect the copyright of a digital good. Illicit copies of music files reach billions per year and there seems to be no way to stop the peer-to-peer file trading with reasonable means.

Doubts about its appropriate design and its enforceability bring up the question whether copyright law is still an adequate governance system for intellectual property rights in the digital age. Are there alternative ways of providing information goods, a more efficient eco-system for ideas than the one copyright law offers?
Modified copyright structures[1] give content creators more options compared to the strict copyright law. But why should content creators use them instead of strong protection of their rights, essentially giving up on something that has been granted to them by law?

Once created, the reproduction (or copying) of an information good does not cost any additional resources. Its distribution is also virtually costless. Therefore, marginal costs of information goods are practically zero. They have public goods characteristics: they are non-rival and non-excludable.
However, Pareto-efficient pricing according to p=MC requires an alternative way of rewarding artists for their work, so that at least their basic reservation costs are covered. Otherwise, there would be no motivation to create in the first place.

Social preferences based on fair and reciprocal behaviour might offer such an alternative. The financial reward for the artists is based on a sufficiently high number of fair-minded consumers who contribute voluntarily (if they enjoy the product). The "contract" between the artist and the consumers of his products relies on a trust-based relationship. In fact, fairness and reciprocity might be regarded as the enforcement device of a deliberately left open contract.
Such voluntary contributions for information goods can in fact be observed in reality (a study of shareware software (Takeyama (1994a)), own preliminary research of the voluntary contributions for digital newsletter articles) and can be theoretically explained by social preferences models. Moreover, lab experiments confirm this behaviour in general (Fehr and Schmidt (2000), Charness and Rabin (2002) and several more).

We apply these two insights – information goods have public goods properties; social preferences are significant among individuals – to test the values of a strict copyright enforcement in the digital age. Our tool of analysis is contract theory. Instead of the standard Principal-Agent-situation with a firm and a worker in the labour market, our model features an artist and consumers in information goods markets. We examine

[1] The Creative Commons license, for instance. See: www.creativecommons.org

three different contract scenarios under information asymmetry and analyse the respective social welfare implications and private investment incentives.

The goals of the paper are twofold. It aims to contribute to the quest for an efficient IPR environment for information goods. We attempt this from a contract theory perspective. Moreover, we want to add an interesting application to the field of behavioural economics.

Our main finding is that implicit or endogenous incomplete contracts may achieve a first-best allocation of information goods, while explicit contracts are limited to second-best results.

It is important to point out that the Principal-Agent relationship we focus on is between an artist and consumers, not between a music label or any other intermediary and consumers. This is based on earlier research about the efficient ownership structure in the music industry: Artists should own copyrights in the digital age. A relationship between two individuals is a prerequisite for any significant social preferences and reciprocal behaviour.

Our paper contributes to the literature on copyright. This strand of economic research started with the first formal analysis of copyright by Plant (1934) who in fact rejected the case for copyright mainly on the grounds of a sufficient first mover advantage to establish the product. Landes and Posner (1989) and Besen and Kirby (1989) are main papers with a general welfare approach. Other important works deal with specific aspects of copying. Liebowitz (1985) established the concept of indirect appropriability, Takeyama (1994b) analyses positive network effects from unauthorised copies and Varian (2000) examines the sharing of information goods. Watt (2000) offers an excellent survey of the literature as a whole.
We particularly consider the welfare effects of copyright for digital content. One recent paper – Yoon (2002) – specifies the optimal level of copyright protection in the light of widespread digital copies. However, they do not take maintenance costs of the copyright system into account as we do.

The rest of the paper is organised as follows. Section 2 explains the economic context of the paper. It gives a brief overview of the three strands of the economic theory we relate to: information economics, behavioural economics and contract theory. Section 3 sets up the basic model and derives the main results. We present some open aspects for later versions of the paper and for future research in section 4 and section 5 concludes.

2. Economic Context:

2.1. Information Goods and Welfare Economics

Much has been written about the New Economy and the revolutionary effects of information technology on the economy. Much has also been put in perspective by serious accounts of the implications like Shapiro and Varian (1999), for example. However, one thing that indeed is about to change on the way to an informational society is the emergence of a number of goods – information goods[2] – that did rarely exist before. Computer software, digital music or e-books for instance are products of the informational society and their attribute of zero marginal costs of reproduction gives them public goods properties.[3] The use of one digital copy does not diminish the value of any other digital copy. Moreover, potential users might hardly be excluded from consumption.[4]

Generally welfare economics calls for perfect market competition as this achieves optimal allocation of resources, however under certain hypotheses. These assumptions can – by and large – be expected to hold for many products of our economy. This is particularly true – and especially relevant in our case – for very homogenous products like books or music CDs. However, the transition from ordinary goods to information goods affects these basic assumptions. The appropriability of digital goods is seriously in question and they cannot be regarded as private goods anymore.
If we then ask the classic question of welfare economics again for digital goods, the answer will not be so clearly in favour of perfect market competition. Arrow analysed the welfare implications related to the production of knowledge. He shows that a free enterprise economy will under-invest in research, because the product can be appropriated only to a limited extent. The price set by the market will exceed the socially optimal one of zero marginal costs, one that would make everybody benefit from the research. He concludes that for optimal allocation to invention some organisation not governed by the profit-and-loss criteria – an alternative to the free market - needs to fund research.

Until recently research and its production of knowledge used to be the only commodity that matched the characteristics of an information good, of course being in fact the quintessential information good. As described earlier the New Economy introduces some products either entirely new as software or transformed from ordinary goods like digital music or e-books; all of them are information goods, though.

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[2] We will also call them digital goods or weightless goods as in related literature, but will focus on the term information goods. Following Quah (2003) they are distinguished from other goods by five characteristics: information goods are non-rival, infinitely expansible, discrete, aspatial and recombinant. More examples include videogames, DNA sequences, news, recipes, sports scores, visual images.

[3] Non-rival and non-excludable.

[4] Peer-to-peer file sharing networks provide the online community with a huge amount of files for free (among them copyrighted music and movie files). The case of Napster is well-known. However, offshoots that emerged after its demise work without a central file server and also exchange a great number of legal files. Recently a court ruled in favour of two online services and for the first time against the Recording Industry Association of America, recognising the legality of P2P services in a way. See Richtel (2003).

It is important to stress again the difference between ordinary goods and information goods in terms of the property rights governance here. While our property rights system is designed for ordinary goods – correctly and with a lot of success – information goods require a more nuanced property rights environment to encourage a socially efficient allocation. This system change appears particularly difficult to understand for ordinary goods that have been flourishing under ordinary property rights, but metamorphosed into information goods in the New Economy.

A number of information goods are already being given away for free: E-books, open source software or computer shareware. However, this can generally be explained with positive promotional network effects that increase revenue indirectly and/or a production that is primarily for personal use.
Some authors explicitly offer their e-books for free. The rationale here is a positive word of mouth effect (a network externality) that increases the actual sales of the real book, the ordinary good. The promotion effect is significant and free downloads are massive.[5] What makes this work is the quality difference between the e-book and an ordinary book. They can be regarded as complements, because the reading experience of a real book is so much better than reading the e-book on a screen. People with a high enough quality preference will buy the real book after getting to know it as a free e-book. Voluntary donations are not really intended here as they would bypass the publisher who is required for book production.
Voluntary contributions of code to open source software are intrinsically motivated. Non-academic literature mentions entertainment, challenge and social ties as the main motivation for programmers (Torvalds (2001)). Economically it can be explained with peer recognition concerns and potential lucrative jobs in the future if the coding is successful. (Lerner and Tirole (2002))
Most computer shareware is programmed out of personal motivation: working out a better way for a simple specific software problem the coder encountered. Giving the software away for free supports the public domain with no additional costs. Takeyama (1994a) presents an empirical study of the shareware industry. The software is distributed under a voluntary payment scheme. The main finding of the paper is that the distribution of returns has a positive expected value even when development costs (time) are considered. Therefore, potential voluntary contributions can make it worthwhile to program shareware.

These reasons do not particularly apply to music products. The marginal quality difference between conventional music products (CDs) and the information good music (MP3s) makes them rather substitutes and not complements (as e-books and real books). Positive network effects of free digital music can not be expected to have a significant positive effect on traditional sales, at least not in the long run. Moreover, making music is rather aimed at entertaining other people. It is not mainly for a personal purpose as computer shareware often is (initially).
However, voluntary contributions from consumers like in the case of shareware might provide an alternative reward system to justify giving away music for free.

[5] Cory Doctorow's novel "Down and Out in the Magic Kingdom" at http://www.craphound.com/down/

2.2. Social Preferences

Social preferences explain economic behaviour moving away from the self-interest hypothesis of neoclassic economics. This departure is based on the results of a vast number of experiments conducted in recent years. (see the survey of Fehr and Schmidt (1999)) However, the concept of social preferences goes back to the very beginning of modern economics – in fact, even beyond that. Adam Smith already stressed the importance of other-regarding preferences in his "Theory of Moral Sentiments".
Without a doubt economic motivation by self-interest does play a major role. The self-interest hypothesis can accurately explain economic behaviour in many areas. Predictions are particularly fine the more competitive markets are and the more homogenous goods are. This is also confirmed by experiments (Smith (1962)). On the other hand, many economic transactions are not about standardised goods and they are not taking place in a competitive market environment. The more personal the exchange is, the more other-regarding behaviour matters (see Smith (1998) and also Fehr and Schmidt (1999)).
Therefore, social preferences "assume people are self-interested, but are also concerned about the payoffs of others." (Charness and Rabin (2002))
Several formal models have been developed recently to describe the role of fairness and reciprocity. Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) both use inequity aversion to model other-regarding behaviour. Models of intention-based reciprocity like Rabin (1993) focus on the intentions of other agents and its impact on behaviour. Social preferences in Charness and Rabin (2002) combine existing theories of fairness and reciprocity and contain three different motivations: an indifference aversion component (agents want to reduce differences between their and others' payoffs), concerns for social welfare (agents like to increase social surplus not just their private one) and a reciprocity part (a desire to raise or lower others' payoffs depending on how nice or not these behaved).
This is the approach we adopt for our model.

The data of Charness and Rabin (2002) comes from 29 different games with 467 participants, making 1697 decisions. Their main goal is to get a better understanding of social motivations and its different types in order to improve formal models that explain social preferences. From the statistical analysis of the experimental results they conclude that all three types are significant, however to a different extent. Social-welfare preferences appear to be the most dominant factor, followed by reciprocity and then difference aversion. While we do not want to discuss specific details of their experiments, one of the results deserves particular spotlight in the context of our paper.
In game Barc7 player A can forgo a (750,0) outcome to give player B the choice between (750,400) and (400,400). Only 6% of the B's choose (400,400) here, while 30% of B's choose this option following either no move or a nasty move of player A. CR conclude the reason for this might be a very strong form of positive reciprocity compared with difference aversion. They conjecture that agents who have just been treated very kindly will not take Pareto-damaging action just to equalize payoffs. They also stress the resemblance to real world situations of this particular game. Although this is the result of just one game and more research needs to be conducted, the relevance of this result to our setting is interesting as will be showed later.

2.3. Contract Theory Framework

Our model framework is based on general contract theory, with the copyright holder of an information good as the principal and a consumer as the agent. Standard contract theory (as in models for the labour market with a firm/manager as principal and a worker as the agent) deals with information asymmetry. The action the agent takes (e.g. effort) usually affects the output, but cannot be contracted on. The output, which is determined by effort and some randomness, is used to write a contract to create incentives and make the agent exert optimal effort. In our setting there is no production function with a randomness term involved. Information asymmetry causes non-contractibility of the payment, not of an effort. This makes our principal agent situation somewhat more straightforward. The principal contracts directly on the action of the agent - if he is able to observe and verify the action, that is.
The simple relationship between copyright holder and consumer is based on the principal contracting the agent to make a payment in exchange for the utility of consuming the music. We will see that this contractual relationship is very trivial for ordinary music goods, but far from that for information goods of music.

Moreover, we integrate insights from the incomplete contracts theory in our framework. We compare explicit contracts that specify all aspects of the relationship with implicit contracts that are much less defined. These endogenous incomplete contracts may outperform explicit contracts in combination with reciprocally fair behaviour of agents. This is based on strong experimental and theoretical evidence from Fehr and Schmidt (2000).[6] They apply their model of inequity aversion to an experiment featuring a manager as principal and a worker as agent. Contrary to the prediction of the self-interest hypothesis implicit contracts are offered by the principal and reach a higher effort level than explicit contracts.

3. The Model

The model describes the relationship between a copyright holder and a consumer from the perspective of contract theory. We consider the transition process from a traditional music industry with ordinary goods to a music industry in the New Economy featuring information goods. Therefore, we distinguish between four different contract scenarios.

The music market with ordinary goods allows for complete contracts. The product – a CD – is standardised and the market relatively competitive. The transaction process of getting the product and paying for it is observable and enforceable. Naturally, contracts are explicit.
In the digital world with information goods this transaction process becomes difficult to observe and we move to an incomplete contracts world. Principals can a) continue to write explicit contracts and monitor to enforce them or b) reduce the price in the explicit contract to compete with pirated copies or c) offer implicit contracts that encourage reciprocal behaviour and voluntary contributions.

[6] A more detailed description and analysis of the experiment can be found in Fehr, Klein, Schmidt (2001)

3.1. The Question of First-Best

Before analysing the four contract variations of the model, we want to focus attention for a moment on the general benchmark of a first best world.
In standard contract theory there exists a certain level of agent action (effort of a worker, for instance) that maximises total surplus. If information is symmetric, complete contracts can be written and the first best can be obtained. Under information asymmetry though, agency costs arise and the optimal incomplete contract induces the agent to exert effort on a second best level only. This logic naturally applies to ordinary goods of the traditional music industry. Similar to the trade off between incentives and risk that reduces the effort of a worker or the costly monitoring scheme that keeps effort at a certain level, the costs of the product would increase, if the payment transaction were not observable and action to enforce paying had to be taken.
However, the first best criterion in markets for information goods is different. Remember that an additional copy can be produced at negligible costs; the marginal costs are zero. In the first best world the price would equal marginal costs as this maximises total surplus. We still have to consider the issue of dynamic efficiency – motivation to produce information goods in the first place (when there is no price charged) – but it is already clear that under information asymmetry a positive price cannot lead to a first best allocation of the information good, only to a second best.
Again, complete contracts – imaginable under perfect information, though not realistic – deliver first-best results as they would allow perfect first-degree price discrimination.

3.2. Set up of the model

Our simple principal agent model describes the relationship between a copyright holder H and a consumer C. The pleasure from listening to the music gives the consumer some utility u, the payment to the copyright holder is denoted as p. In complete contracts this payment p is equal to the price the copyright holder sets, whereas it can be zero in incomplete, explicit contracts when piracy occurs. However, pirated copies cause some disutility d to the consumers as they might be of lower quality and bear the risk of a virus attack. Finally, in incomplete, implicit contracts there is no price but a voluntary contribution v that C can make.
Under asymmetric information H has the option of implementing a monitoring scheme, which costs K. This scheme increases the probability of the agent being convicted of copyright infringement from 0 to q. Getting caught as a pirate means a financial/moral damage of f for the agent as a result from government prosecution. Without a monitoring system in place piracy is impossible to observe and the government cannot take action.
In order to focus on the contractual problem we do not introduce a utility function that distinguishes between monetary payoffs and non-monetary (dis-)pleasures. Thus, we transform the non-monetary utilities u, d, f and express them directly in monetary terms. Agents' payoffs are then calculated in monetary terms.
Furthermore, we assume the risk-averseness of both principal and agent to be neutral. The participation constraint of the agent is: $u \geq p$ The representative consumer we analyse in the contract cases just fulfils this condition. He is the marginal consumer with u=p

The principle has to invest resources (time, money) to create the good. He could spend his time doing something else and therefore we call this investment his reservation costs R.[7]
There are two stages of the model: one for production, one for consumption. The principal incurs the fixed reservation costs in stage 1 and has to decide whether to produce or not. In stage 2 the good is priced and consumed. The pricing is derived from the different contract scenarios. The costs incurred in stage 1 are sunk and will be ignored in the second stage.

3.3. Contract Designs

3.3.1. Ordinary Goods / Complete Contracts

Under perfect, symmetric information in the traditional music industry framework complete contracts can be designed. The analysis under complete contracts is very straightforward and mainly serves for a better understanding of the bigger picture.
In this situation the principal H has some variable costs of production c. Remember that the ordinary good is not costless to reproduce in contrast to the information good. We abstract from occasional shoplifting and assume that the agent's action of paying for the product is perfectly observable. Thus, a complete and enforceable contract can be written.

The condition for the optimal contract is: $p = c$

The market allocation (perfect competition[8]) with explicit contracts delivers first best results for ordinary goods.

3.3.2. Information Goods / Incomplete Contracts

The following three cases describe the music business in the New Economy where the product is an information good. The implications of this transition for the model are twofold: ordinary goods convert to information goods, complete contracts have to be replaced by incomplete contracts.
The principal now faces a situation of asymmetric information. He does not possess the means to observe the payment transaction easily as he used to in the traditional industry. The payment becomes non-contractible, contracts become incomplete.

3.3.2.1.Explicit Contracts

a) Strong Copy Protection with a Monitoring System

Pirated music is widely available in file sharing networks and consumers can download songs for free. The copyright holder cannot contract on the payment.

[7] In the related literature this term is also known as 'the cost of expression' (Landes and Posner (1989) or the fixed cost of development (Yoon (2002)).
[8] We do not consider the complications from oligopolistic pricing in the music business here in order to focus on the contract issue.

However, the principal can introduce what is known in the literature as a verification technology. He implements a monitoring system that helps to detect consumers who do not pay, but rather use the P2P software. This investment in verification technology makes copying verifiable at probability q = 1/3. To simplify things we assume that this signal (being caught) is perfect and always results in litigation of the agent in court for copyright infringement.[9] This punishment f is exogenous as it is set by legislation. It is supposed to work as a threat only though as it should keep the agent from shirking/pirating. At the optimal price p* the agent chooses to buy the product, since the risk of getting caught when copying is too high for him.
Naturally, it is costly to implement the verification system. The huge traffic of P2P networks needs to be monitored and tracked which is technologically very demanding.[10] Also the identity of online users has to be revealed by the internet service provider which poses some legal complications.[11] We denote the fixed cost of implementing a monitoring system as K.

Payoffs are (using a representative consumer):

$$\begin{array}{lll} \Pi_H = p - k & & \Pi_H = 0 \\ & \text{if } p \le q \bullet f \quad \text{and} & \text{if } p > q \bullet f \\ \Pi_C = u - p & & \Pi_C = u - q \bullet f \end{array}$$

If the threat of the punishment is meant to work, the principal must set a price lower or equal of the expected damage to the agent. Instead, the agent chooses to copy, when the price he is charged exceeds the risk of getting punished.

The optimal contract therefore features: $p_{monitoring} \le q \bullet f$

b) Low Price to compete with Pirated Copies

Another option for the principal is to accept the fact that digital copies of the product are readily available through file-sharing P2P networks. Illicit copying is tolerated and not actively prosecuted. The principal does not invest in the monitoring system.
Although pirated copies are for free, they do cause some costs for the consumers. Notice that the quality of consumption is equal no matter if it is a direct copy or pirate copy. It is the transaction cost that is different, though. The quality of the downloaded music file cannot be verified before and it might be a bad recording. As a result the user might want to get another pirate copy. His inconvenience increases. The

[9] The first direct legal action against individuals was a lawsuit of the Recording Industry Association of America against four college students who were running "mini-Napsters" or online directories on their computers, facilitating file sharing for fellow students on the university network. They settled and paid between 13,000 and 17,000$. See Harmon (2003).
[10] The music industry is very active to develop electronic countermeasures against online piracy; some of them legal, some illegal. See Sorkin (2003) and also Wired (2003)
[11] The Recording Industry Association of America is in a legal battle with Verizon – a major internet service provider. It claims recent legislation obligates Verizon to reveal the names of customers if they are suspected of infringement. Verizon argues the law violates free-speech and due-process rights protected by the Constitution. See New York Times (2003).

downloader also runs the risk of getting a file that is infected with a virus and which might in turn damage his computer. Moreover, one could also think of moral burdens that come with something not exactly approved by society.
We aggregate these transaction costs in the disutility from copying d, a constant.

All these costs for the consumer appear if the product comes from piracy, they do not if the product comes directly from the principal. Thus, a reasonable strategy for the principal would be to take advantage of this cost difference and offer the product for a very low price that matches the consumer's disutility from copying – as long as this still covers his reservation costs. The pricing should be so attractive that buying the high quality product is more convenient than getting a low quality copy for free.

The copyright holder cannot charge more than the monetary equivalent of the disutility from copying. Otherwise, the consumer will opt to pirate music instead of buying it legally.

Payoffs are:

$$\Pi_H = p \quad \text{if } p \leq d \qquad \text{and} \qquad \Pi_H = 0 \quad \text{if } p > d$$
$$\Pi_C = u - p \qquad\qquad \Pi_C = u - d$$

The optimal contract is defined as: $p_{low} \leq d$

This explicit contract gives the copyright holder a profit of d. The consumer gets a utility of u – d, which is equal to his reservation utility. Surplus basically shifts to the consumer.

3.3.2.2.Implicit Contracts

c) Voluntary, reciprocal Contributions

Finally, the principal can offer the product for free relying on enough voluntary contributions out of consumers' social preferences that cover or exceed his reservation costs. It seems important to stress again that only because of the particular characteristics of information goods he has this choice. This could not work with ordinary goods involved since giving these away is costly, but not giving away information goods.
In contrast to an explicit contract a deliberately left-open contract leaves room for fair and reciprocal behaviour between the agents.
The fact that the principal offers the product for free – despite other options – is regarded as kind behaviour in the eyes of the consumer. A fair-minded consumer – one with social preferences – will recognise and appreciate the effort of the principal and will reciprocate. He contributes voluntarily. Obviously, he will only give a fraction of his actual utility from the song and he will certainly not contribute if he finds out he does not like the music at all. On the other hand, a selfish consumer does not care about the income of the principal nor about any kind behaviour towards him. He does not contribute and free rides.

In the literature of behavioural economics usually a ratio of 60% selfish to 40% fair-minded individuals is assumed (Fehr and Schmidt (1999), Charness and Rabin (2002)) and we adopt this measure. However, certain experiments suggest that reciprocal behaviour of individuals is even stronger when the amount of effort involved in the relationship (known as "earned property rights" (Fahr and Irlenbusch (2000), V. Smith (1998) among others) is taken into account. Moreover, the social, personal transaction between the artist and a consumer instead of an impersonal market exchange with a record label matters, if the copyright holder is the artist.
Again, transaction costs as in file sharing use do not play a role when the principal makes the product freely available on his web site. The direct download from the site of the copyright holder or a licensed intermediary is quick and of high quality.

In order to incorporate social preferences we use a simple two-person model from Charness and Rabin (2002), which we slightly adjusted to allow for positive reciprocity. This model is very conceptual and crude, but it captures the main elements and permits simple applications. More sophisticated formal models exist, but they are very complex and not yet suitable to explain experimental evidence or to be used in applications. For our purposes the simple version appears to be sufficient.

V describes the utility of an agent and is defined as follows:

$$V_C(\Pi_C, \Pi_H) = (\rho \bullet r + \sigma \bullet s + \theta \bullet t) \bullet \Pi_H + (1 - \rho \bullet r - \sigma \bullet s - \theta \bullet t) \bullet \Pi_C$$

where:

$r = 1$ if $\Pi_C \geq \Pi_H$ and $r = 0$ otherwise

$s = 1$ if $\Pi_C < \Pi_H$ and $s = 0$ otherwise

$t = 1$ if H behaved nicely and $t = 0$ otherwise

$0 < \sigma < \rho \leq 1$ is the parameter condition for social welfare preferences with $\sigma \leq 1/2$ to have C not be more concerned about H than about himself.

$\theta > 0$ as the measure for reciprocity

$\Pi_C = u - v$ and $\Pi_H = v$

Furthermore we assume the ratio of fair-minded consumers α to be 40%. The voluntary contribution v of the agent is a fraction g of his actual utility from the music. It is determined by his self-interestedness (ρ or σ) and his tendency to reciprocate (θ). Concerns for the overall welfare and actions of the principal that affect the social welfare (the Pareto-damaging implementation of a verification technology) are therefore integrated in the agents' preferences. To make the model more straightforward, yet not less realistic, we focus the analysis on a single, representative consumer. He contributes with a probability of α.

In order to allow for a discrete not binary choice of v we have to endogenise the contribution decision of the agent. We assume the fraction g of u to be set by the social preferences parameters ρ and θ. It follows that:

$$v = (\rho + \theta) \bullet u$$

Naturally, the implicit contract does not feature a price. However, fairness and reciprocity might be regarded as an enforcement device of the endogenous incomplete contract. No potential efficient consumer is deprived of a benefit with the price equal to marginal cost. Voluntary contributions to the principal can exceed his reservation costs and motivate him to offer his products for free.

The optimal contract is: $p_{implicit} = 0$

DIAGRAM WITH ALL PAYOFFS

3.4. Stage 2: Consumption

We model the demand of consumers in a very basic way, similar to Yoon (2002). Consumer's valuations are uniformly distributed over the interval [0,10]. Prices are also confined by this interval. Based on the contract design analysis above they are ranked in the following order:

$$0 = p_{implicit} < p_{low} < p_{monitoring} \leq 10$$

Remember that any fixed costs incurred in stage 1 (the reservation cost R or the monitoring cost K) are sunk now and that marginal costs are negligible.

a) Strong Copy Protection Scenario

The condition of $p_{monitoring} \leq q \bullet f$ defines the price in the strong copy protection scenario. We assume the threat of court litigation to be smaller than 1 and larger than d.
The principal uses a monopolistic pricing policy to maximise the profit. However, he might be forced to lower the price in order to fulfil the contract condition (this is not yet implemented).

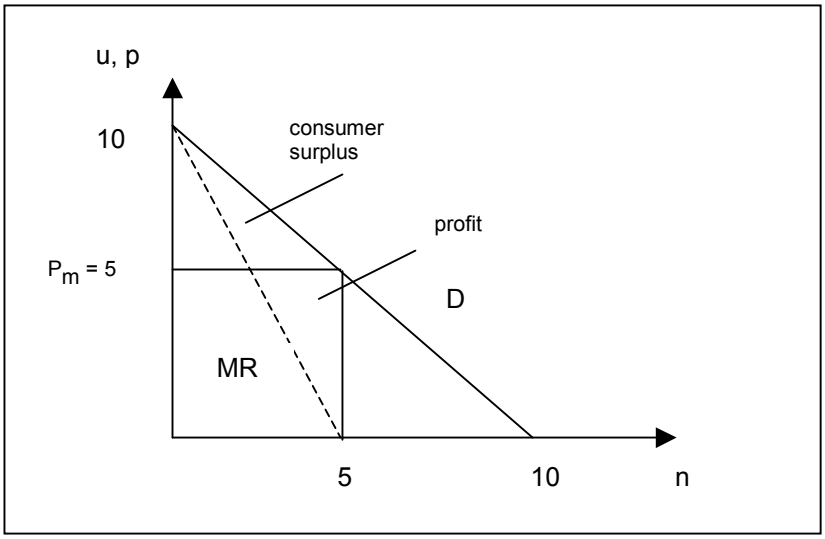

Figure 1: Supply and demand under strong copy protection

If the threat of punishment is not a binding condition for the price, then the principal can set the monopoly price of 5. He maximises revenue and his profit is 25. Consumer surplus is 12.5 and the usual deadweight loss results.

b) Competition with pirated Copies Scenario

If the principal decides to compete with copies obtainable in P2P networks, his price cannot exceed the disutility agents experience from copying: $p_{low} \leq d$

As mentioned before we assume these transaction costs (the virus risk, moral issues, inconvenience from downloading) to be constant across consumers. It is easy to see that in the monopolistic environment for realistically small values of d the profit maximising price the principal chooses will equal d. We assume the disutility from copying to be 1.

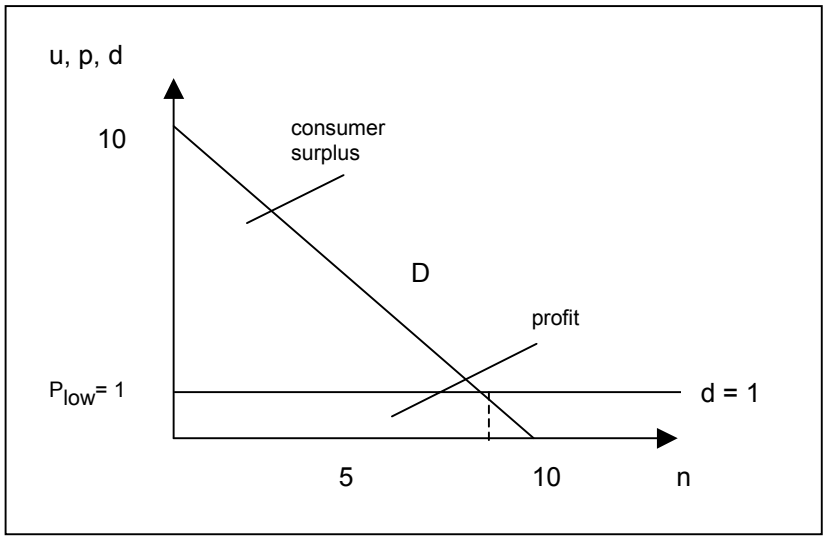

Figure 2: Supply and demand with a very low price

Being forced to set a very low price the profit of the principal significantly shrinks. Notice however that no monitoring costs are incurred. With our linear, uniformly distributed demand a price of 1 results in a revenue of 9. The consumer surplus is 40.5. Only a few potential consumers are kept from a beneficial trade.

c) Voluntary Contributions Scenario

There is no price charged in the implicit contract scenario. Revenue for the principal comes from voluntary contributions by agents. These payments are determined by the social preferences parameters and the ratio of fair-minded consumers, but also depend on the actual utility each consumer gets.

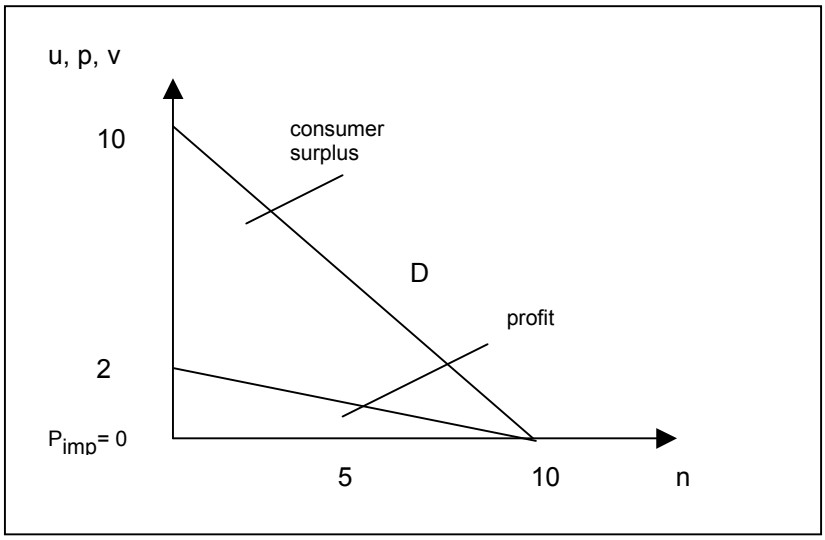

Figure 3: Supply and demand with voluntary contributions

With a price of zero no consumer is excluded from the benefit of the product. Consumer surplus is maximised, however a certain fraction α of consumers returns $\rho + \theta$ of their utility u to the copyright holder because of their social preferences. Again, we transform α into the probability of every consumer to reciprocate. Voluntary contributions (for common parameter values of $\alpha = 0.4$ and $\rho + \theta = 0.5$) amount to 10 and are the principal's profit. The remaining consumer surplus is 40.

This shows that for certain parameter values consistent with social preferences sufficient income for the principal can be generated. This happens despite the fact that the fraction of purely selfish agents does not contribute. Clearly, this outcome depends on the specific choice of parameters and the precise situation we model has not yet been covered and analysed in experiments. But we feel the related evidence from studies in behavioural economics is encouraging enough and the implications for digital markets are substantial.

We already mentioned one specific game of Charness and Rabin (2002) that delivered surprising results and calls into question the prevailing doubts regarding positive reciprocity shown in conventional games studied. Another of their games, Berk 14, appears to be an even closer fit for the simplified payoffs of our model and underlines the significance of positive reciprocity: Player A chooses between a (800,0) outcome and giving player B the choice between outcomes (0,800) and (400,400). 55% of the B's make the balanced choice here, while only 22% of B's choose this option in the controlled version (a pure dictator game) without a move of player A.

However, it supports the intuition of our scenario. The principal has the choice between two outcomes. One gives him some surplus although limited because of the monitoring costs and leaves not much for the agent. The second lets the agent decide between two options. He can "cheat" and abuse the trust (no payoff for the principal, everything for the agent) or he can share the benefit with the principal by contributing

voluntarily. Following the kind first move of the principal (he forgoes trying to enforce an explicit, welfare-reducing contract) the agent is more likely to act reciprocally.

3.5. Stage 1: Production

The detailed implications on the production decision – the private incentives for the principal – will be included in a later version of the paper.

However, it is clear that the principal's profit can exceed his fixed costs at production stage (the reservation cost R and in case a) R plus the monitoring cost K) to motivate investment in all three scenarios.

4. Open Aspects

Several aspects of this early version of the paper have not been covered properly yet.

The integration of a bonus like in Fehr, Klein and Schmidt (2001) makes the contract even more incomplete and thus leaves more room for reciprocity (from both sides). A bonus in the context of the music business could be exclusive access to concerts or backstage, special merchandising for consumers who did contribute. The bonus cannot be specified ex ante, though.
An important question is, who the copyright holder actually is. Is it the record label like in the traditional music industry or the artist? The implications on the fair behaviour of agents (an impersonal market trade or a social personal exchange) and also on the definition of the reservation cost are significant.
Moreover, the contribution of the agent might lead to an overall welfare increase. With enough contributions the artist continues to be creative, which is good for the agent and society when future creative works are taken into account. This would increase the payoffs for principal and agent.

Finally, the social welfare analysis has to be generalised and the decisions at the production stage – the private incentives to invest – have to be covered for the different contract scenarios.

5. Conclusion

The paper aims to integrate the peculiarities of digital information into the social preferences framework. It describes a contractual model based on incomplete contracts theory that provides an alternative way to offer information goods – more efficiently we conclude. Some key parts of the paper are yet to be analysed in this preliminary version. It opens up an interesting field for future research. Modified experiments to test for social preferences in digital age contexts would be a logical next step.

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