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Abstract

Information goods are essentially public goods as soon as they are made available in digital form on the Internet. Therefore, firms (or providers) of informations goods are forced to consider alternative payment schemes to eliminate the free rider problem. The present paper introduces a mechanism by which a profit maximizing vendor announces a total price for making some information good available and potential users are making volutary contributions. It is shown that this mechanism eliminates the free rider problem under the assumption of complete information. The informational requirements are examined with respect to practical application and the mechanism is compared to a similar payment scheme launched by author Stephen King in an attempt to sell his novel "The Plant" exclusively on the Web. Finally, a small field experiment will shed further light on the applicability of the proposed mechanism.

Keywords: Information goods, Public Goods, Selling Mechanism, Internet.

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1 Introduction

The Internet facilitates a variety of ways to exchange goods. Ways that only rarely appear in traditional markets; frequent use of auctions, producers distributing their goods for free (including freeware, shareware and shareware-dual-track), environments where users can swap digital goods (MP3 music files, software, video etc.) without paying royalties like Napster (in its original form) or WinMX, personalized prices, frequent emergence of clubs and wholesale societies etc.

There are several features that may explain why these "alternative" ways of exchange have become prominent on the Internet, see e.g. Delong & Froomkin (2000) and Shapiro & Varian (1999). In the particular case of information goods (or digital goods) *non-excludability* seems to be an important characteristic. Indeed, since information goods are both easy and cheap to copy they essentially become public goods as soon as they are made available in digital form on the Internet. In contrast, on markets for traditional commodities producers can easily exclude non-buying agents from consumption.

Without excludability markets fail and firms are faced with the problem that although their products are wanted they are not being produced simply because non-excludability makes consumers free ride. Therefore, if the total willingness to pay among potential users is high enough to cover the costs of production some mechanism other than the market must be introduced in order to ensure social efficiency. In other words, firms are forced to seek for alternative payment schemes in order to cover their costs of production. The problem is well known: For example, from Radio and TV broadcasting where commercials have been the primary source of income. Lately also the music industry has been forced to improve its creativity facing the consequences of Internet sites like Napster, Gnutella and their successors, see e.g. Pfahl (2001).

Probably, we have only witnessed the beginning of a process where firms or individual providers try to sell their information goods in more "ex-

otic" fashions than usual markets. When we specifically mention individual providers it is because it is an open question whether many firms as we know them today (record companies, publishing companies etc.) will continue to exist in their present form since the Internet makes it possible for the individual provider of, for example, music or novels to trade directly with consumers, see e.g. Hillesund (2001) and Pfahl (2001).

Recently, the author Stephen King received a lot of attention for his attempt to sell his novel "The Plant" exclusively on the Web. King chose a mechanism designed as follows: Two installments were offered to anyone who registered. These installments could be downloaded for free but the users were invited to pay 1 dollar each to King for the privilege. It was stated that if 75 percent of those who downloaded also paid he would continue to offer new installments until the novel was complete. In the beginning people generally paid but already at the fourth installment less than half the readers were paying and the process ended.

There may be several explanations of why the novel was not completed and the mechanism failed. First of all, by offering the novel on the Web, King made his installments public goods and with public goods there are always incentives to free ride. More specifically, though, the mechanism used by King gives rise to a lot of uncertainty both with regard to the total price for a copy of the complete novel and with regard to whether the novel will be completed at all. This may have reduced peoples' willingness to pay as well as their eagerness to download and read the installments. On top of this King charged a fixed amount of 1 dollar and thereby excluded smaller payments from people with a lower willingness to pay.

In the present paper, we introduce an alternative mechanism that eliminates the free rider problem, the uncertainty as well as the fixed payment problem associated with King's mechanism. The mechanism is simple: A provider (or vendor) announces a fixed total price for some information good and a date by which the price should be paid. Each potential user decides how much to contribute. If the sum of their contributions exceeds the total

price then the information good is made available on the Web - otherwise not and contributions are returned. Clearly, the provider needs to have a good estimate of the total willingness to pay in order to maximize his profit: If he sets a price exceeding the total willingness to pay then the information good is not provided despite the fact that total willingness to pay may exceed the costs of providing the information good; on the other hand, if he sets the price too low he is foregoing profit.

Although the mechanism is very appealing in its simplicity, it has some limitations including rather strong informational requirements. These limitations as well as ways to deal with them will be discussed in detail in the following sections. Moreover, a small field experiment will shed further light on the applicability of such a mechanism.

The paper is structured as follows: Section 2 defines a mechanism which theoretically solves the free rider problem associated with information goods. Section 3 discusses the informational requirements and evaluates the consequences in case these requirements are weakened. Section 4 discusses further issues of practical relevance when using the mechanism. Section 5 compares the proposed mechanism with King's mechanism. Section 6 presents a small field experiment and, finally, Section 7 closes with concluding remarks.

2 A Dynamic Game with Voluntary Contributions

We consider a profit maximizing provider of some information good and a set of potential users. To simplify the exposition we assume that the provider only has to decide whether one information good shall be made available on the Web or not. If the information good is produced and made available the cost is c, if not the cost is zero. All potential users are endowed with individual initial wealth w and an individual utility function u. The utility function is continuous and increasing in wealth, and availability of the information good increases utility. For each user the willingness to pay is

given by a number v that equals the utility of using the information good having wealth $w - v$ and the utility of not using it having wealth w.

Now, it is assumed that the wealth exceeds the willingness to pay for each user and that total wealth exceeds the costs of production in order to make the problem non-trivial. Moreover, it is a crucial assumption that there is *complete information*, i.e., all information concerning wealth and utility functions of the agents is common knowledge among the agents. This assumption is subject to further discussion in Section 3.

Since the information good has the character of a public good (once provided consumption cannot be excluded) the provider cannot hope to sell more than one copy on a usual market. Therefore the revenue cannot exceed the highest willingness to pay and this may very well be less than the cost c of making the good available. In other words, even though the total willingness to pay exceeds the costs of production we may risk that the good is not made available.

Rather than selling individual copies, the provider has to use an alternative selling mechanism in order to maximize profits: Consider a "dynamic game" where, at stage 1, the provider announces a price, π, for making the information good available, i.e., the strategy set of the provider is $[0, \infty)$. At stage 2, all potential users assess their willingness to pay for the good and submit their voluntary contributions σ, i.e., the strategy sets of the users are $[0, w]$. If the sum of all contributions exceeds the announced price the good is made available and users pay their contributions to the provider, otherwise everything remains at status quo.

Using the principle of backward induction we first analyze the behavior of the potential users. Suppose that the total willingness to pay is smaller than the announced price then we remain at status quo, i.e., "no production" is the only outcome that cannot be blocked by any group of potential users - contributing more than v might lead to production in which no user is interested. If the total willingness to pay exceeds the announced price then "production" is the only outcome that cannot be blocked by any group of

potential users. However, there are many supporting strategy profiles, i.e., all profiles where each individual contribution is less than or equal to the willingness to pay and they add up to the announced total price: No user will benefit from contributing more since production is already ensured and no one will benefit from contributing less since this would imply that the good is not made available.

Given this behavior among the users, it is clear that the profit maximizing strategy of the provider is to announce a price equal to the total willingness to pay which is known according to the assumption of complete information.[1]

Equilibria in the above game, i.e., the described strategies of both the users and the provider, are *efficient* in the sense that the information good is produced and made available if and only if the total willingness to pay exceeds the cost of production. Moreover, the provider captures all gains of exchange. Consequently, a monopolist with complete information who is selling an information good is able to first-order price discriminate despite the fact that non-excludability is an important characteristic of information goods. In other words, within the framework of the model, selling information/digital goods does not constitute a problem with respect to profitability and efficiency - it only calls for a different selling mechanism. Note, further that even if the provider could "privatize" the information good in the sense of excludability it would not be profitable since a fixed price for all users would reduce the profit. However, the assumptions of the model may prove to limit its applicability, as we shall now discuss.

At first glance it appears to be somewhat surpricing that the provider is able to first-order price discriminate in the presence of non-excludability since public goods give incentives to free ride. However, the problem of free riding is caused by the fact that no users find themselves pivotal. That is, no user finds that their contribution determines whether the information good is provided or not and hence find it an optimizing strategy to avoid

[1] Technically speaking, this equlibrium is the unique subgame perfect strong Nash equilibrium of the game.

contributing. Full information as above is in effect making every user pivotal and thus solves the problem of free riding. Now, with incomplete information free riding reappears as will be demonstrated in Section 3.2. below. In particular it can be noted that the market ought to be designed in such a way that the probability for each user of being pivotal is made as large as possible, as will be discussed in Section 4.

The simple voluntary contribution mechanism used in stage 2 of the above game replicates the mechanism in Bagnoli & Lipman (1989) where it is analyzed with respect to stability and welfare.

3 Complete information?

In practice the provider as well as potential users will never have complete information in the above sense. This problem is twofold since on the one hand, for a given price, π, the users may not know the total willingness to pay and thereby be uncertain about the other users' contributions. On the other hand, the provider may not know the total willingness to pay (even in case it is common knowledge among the users) and hence may have problems in determining the price π such that profit is maximized.

If the latter problem occurs, various forms of marketing research such as consumer surveys, observational research etc. may prove useful in obtaining an estimate of the willingness to pay. To the extent that the estimates are precise the mechanism described above is still reliable although it is inefficient in the sense that there is a chance for a total willingness to pay that is below the announced price (and above the costs of production). In short, there may be a trade off between efficiency and profitability that is absent in the complete information scenario.

In order to illustrate the consequences of incomplete information among risk neutral agents we consider the following example: Assume that a profit maximizing provider has zero cost in making some information good available and that there are two potential users with two possible levels of willingness

to pay, v and v^* where $0 < v < v^*$. Assume that the probabilities for each of the four possible states is given by the following matrix where $\alpha+2\beta+\gamma = 1$.

	v	v^*
v	α	β
v^*	β	γ

This prior distribution is common knowledge among all agents and individual users know their own willingness to pay.

3.1 Partially complete information

First, we consider a scenario where both users know their own as well as the other user's willingness to pay. The provider on the other hand only knows the prior distribution - this may capture situations where the provider is less in touch with market trends than the users themselves (for example some parts of the music business). Now, the provider's problem is to set a price that maximizes expected profit. In short, he has three options; $2v, v + v^*$ or $2v^*$. If the provider sets a price equal to $2v$, this also becomes the expected profit since both users will contribute v with probability 1. If the price is set at $2v^*$, the expected profit is equal to $2\gamma v^*$ since there is only a probability of γ for the case where both users have a willingness to pay that equals v^*. Finally, if the price is set at $v + v^*$, the expected profit is $(1 - \alpha)(v + v^*)$ since the only case where the good is not provided is where both users have a willingness to pay that equals v. Hence, the optimizing strategy for the provider is to set the price

$$\pi = \begin{cases} 2v & \text{for } v \geq \max\{\gamma, \frac{1-\alpha}{1+\alpha}\}v^* \\ v + v^* & \text{for } (\frac{2\gamma}{1-\alpha} - 1)v^* \leq v \leq \frac{1-\alpha}{1+\alpha}v^* \\ 2v^* & \text{for } v \leq \min\{\gamma, \frac{2\gamma}{1-\alpha} - 1\}v^*. \end{cases}$$

Note that, depending on the parameters there may be two or three price regions. In case of two regions the price is either $2v$ or $2v^*$ and in case of three regions the price may also be $v + v^*$ (as implicitly assumed in Figure 1).

If the difference $v^* - v$ is sufficiently small then the provider chooses the smallest price, $2v$, ensuring efficiency with a limited loss of profit compared to the complete information scenario. On the contrary, if the difference is sufficiently large the price should be $2v^*$ which results in inefficiency because with probability $1 - \gamma$ the good is not sold even though the price ensures maximal expected profit (see also Figure 1). To sum up; *the expected profit in the partially complete information scenario is strictly smaller than the expected profit in the complete information scenario.*

3.2 Incomplete information

Secondly, consider a scenario where both users only know their own willingness to pay and all three agents know the prior distribution - this captures situations where both the provider and the users are equally uninformed. As before there are two obvious candidates for a price; $2v$ and $2v^*$ with expected profit $2v$ and $2\gamma v^*$ respectively. However, contrary to the first scenario the third price is now set between $2v$ and $v + v^*$ because if the price is $v + v^*$ then the expected utility of truth-telling for v^*-types is zero while it may be strictly positive in case of lying (as there is a probability of $\gamma/(\beta + \gamma)$ that the other user is a v^*-type yielding expected utility $(\gamma/(\beta + \gamma))(v^* - v) \geq 0$ of lying) - thus giving users of v^*-type incentives to free ride. Given a price $v \leq \bar{\pi} \leq v + v^*$ there is an equilibrium in the stage 2 game $(\sigma, \sigma^*) = (v, \bar{\pi} - v)$ with $v^* - \sigma^* \geq (\gamma/(\beta + \gamma))(v^* - v)$ which implies that the provider shall set the price

$$\bar{\pi} = \frac{2\gamma}{1 - \alpha + \gamma} 2v + \frac{1 - \alpha - \gamma}{1 - \alpha + \gamma}(v + v^*).$$

Given the price $\bar{\pi}$ the provider's expected profit is $(1 - \alpha)\bar{\pi}$.

Thus, the optimizing strategy for the provider is now to set the price

$$\pi = \begin{cases} 2v & \text{for } v \geq \max\{\gamma, \dfrac{(1-\alpha-\gamma)(1-\alpha)}{(1-\alpha-\gamma)(1+\alpha)+4\alpha\gamma}\}v^* \\ \bar{\pi} & \text{for } (\dfrac{(3(1-\alpha)+\gamma)2\gamma}{((1-\alpha)+3\gamma)(1-\alpha)}-1)v^* \leq v \leq \dfrac{(1-\alpha-\gamma)(1-\alpha)}{(1-\alpha-\gamma)(1+\alpha)+4\alpha\gamma}v^* \\ 2v^* & \text{for } v \leq \min\{\gamma, \dfrac{(3(1-\alpha)+\gamma)2\gamma}{((1-\alpha)+3\gamma)(1-\alpha)}-1\}v^*. \end{cases}$$

Since, it is easy to show that

$$\frac{(1-\alpha-\gamma)(1-\alpha)}{(1-\alpha-\gamma)(1+\alpha)+4\alpha\gamma} \leq \frac{1-\alpha}{1+\alpha},$$

$$\frac{(3(1-\alpha)+\gamma)2\gamma}{((1-\alpha)+3\gamma)(1-\alpha)}-1 \geq \frac{2\gamma}{1-\alpha}-1,$$

we see that incomplete information among the users results in a weakly decreasing lower bound for the low price, $2v$, and a weakly increasing upper bound for the high price, $2v^*$, compared to the partially complete information scenario where the users had complete information about the other users willingness to pay. Hence, the following two observations can be made:

Observation 1: *If the provider chooses the price $2v$ or the price $2v^*$ in the partially complete information scenario this remains the optimal price in the incomplete information scenario as well.*

Observation 2: *If the provider chooses the price $\bar{\pi}$ in the incomplete information scenario then he chooses the price $v+v^*$ in the partially complete information scenario.*

Figure 1 compares the price schemes of the partially complete and incomplete information scenarios in case all three price regions are possible for both scenarios.

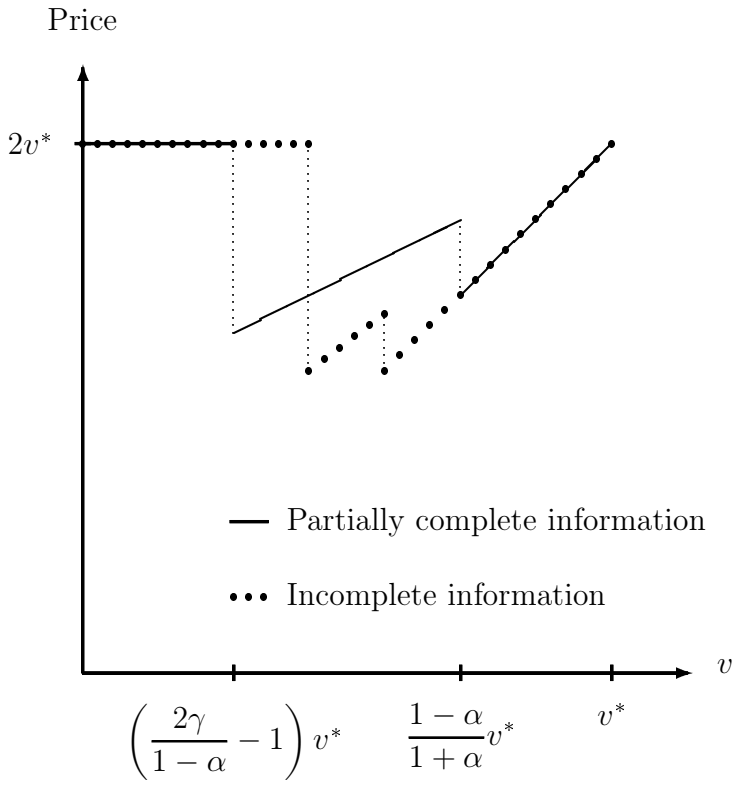

Figure 1: *Price as function of v for* $\frac{1-\alpha}{1+\alpha} \geq \gamma$.

To sum up; *the expected profit in the incomplete information scenario is weakly smaller than the expected profit in the partially complete information scenario.*

Finally, it is hardly surpricing that the problem of free riding introduced by incomplete information seems to become worse with an increasing number of users as each user has a smaller chance of being pivotal. Hence loosely speaking; the more the scenario deviates from partially complete information the more it becomes important for succesful use of the mechanism that the number of users is limited.

3.3 Information and profit

In conclusion, weakening the informational requirements the mechanism still works but expected profits may now be reduced (even considerably) as the provider is no longer guaranteed to sell his product. In fact, the following theorem is a direct consequence of the above analysis:

Theorem: *Let* $\Pi_C(v, v^*)$, $\Pi_P(v, v^*)$ *and* $\Pi_I(v, v^*)$ *be the expected profit in the complete, partially complete and incomplete information scenario respectively. Then*

$$\Pi_C(v, v^*) \ > \ \Pi_P(v, v^*) \ \geq \ \Pi_I(v, v^*).$$

In other words, decreasing information leads to decreasing expected profits. It is clear that the provider is always better off knowing the willingness to pay among the users. However, such information is relative costly to obtain as it involves data mining procedures, consumer surveys etc. What seems more interesting though is that *any action taken by the provider that may increase the information among the users will tend to increase his profitability.* This conclusion is in line with the findings in Crémer & McLean (1985) concerning allocation mechanisms under asymmetric information.

Consequently, record companies ought to induce the formation of fan-societies via the Web and software companies ought to support the formation of user-groups etc. – all in order to increase communication (and thereby information) between users with respect to their "types". The Web itself seems to facilitate such actions since it involves very limited costs for individuals to meet and exchange information in cyber space.

Finally, more sophisticated mechanisms may be developed using a Bayesian approach as done for private goods in Crémer & McLean (1988). However, such mechanisms involve highly complex strategic considerations by all participants and it is therefore an open question whether potential real life users are able and willing to attend.

4 Market design

The interaction between market participants is of course much richer and more complex than the immediate impression given by the models in the previous sections - even though these models do provide valuable insights. Therefore the actual market design with all its pratical issues becomes crucial for successful implementation of the mechanism suggested in Section 2.

For example, some information goods may appeal to users that for one reason or the other are prevented from contributing to their financing. For such *evergreens* it may be that at any point in time the willingness to pay is below the costs of production, and hence prevents the release of the product, although the discounted willingness to pay exceeds those costs. Hence, trying to sell evergreens using the suggested mechanism may result in inefficiency and will surely result in lower profits for the provider.

Consequently there appear to be two strategies for the provider depending on the perception of the product:

- If the product is perceived as a "here today and gone tomorrow" good the mechanism suggested in Section 2 appears to be applicable.
- If the product is perceived as an evergreen it may prove worthwhile to enforce excludability by aggressive protection of copyrights. Indeed, companies like Disney fight hard to maintain their property rights knowing that their products are evergreen material.

Moreover, since information goods are recognized by the market as being experience goods the existence of trailers for movies, downloadable samples of music, free α-releases of software etc. is a natural part of the market design. This is discussed in detail in Shapiro & Varian (1999). Distributing free samples of information goods on the Web is essentially costless for the provider so it does not seem to influence the applicability of the mechanism suggested in Section 2 above. It is, however, important to realize that samples are also public goods and hence has to be sufficiently different from the products themselves in order not to cause unwanted competition. Technically, to

distribute free samples corresponds to introduing an incomplete information scenario rather than letting users stay in complete ignorance with respect to their willingness to pay. As mentioned in Section 3, providers ought to follow up the release of free samples by actions which enable potential users to communicate in order to change the situation from incomplete to partially complete information.

Apart from product characteristics it is important to be aware of any aspects of practical design that influences the strategies of the users. For example, the experience of Internet auctions on eBay and Amazon indicates that bidding history as well as whether the auction uses hard or soft closure (that is, whether the auction closes at a fixed date or continues as long as there is at most some prespecified amount of time between the bids) is highly important for bidding strategies, see Roth and Ockenfels (2000) and Ockenfels and Roth (2001).

It appears that the same kind of considerations are relevant in our setting. Loosely speaking, hard closure seems to increase the likelihood of free riding since users in general have small chances of being pivotal. This corresponds to sniping behaviour (last minute bidding) as observed in Internet autions with hard closure. On the other, a soft closure may induce users to make incremental contributions until the total price is reached.

Finally, the fact that most providers are in the market for longer periods of time makes the trading of information goods a dynamic proces rather than a one-shot situation. This fact may profoundly influence the strategies of all involved agents since users may expect that by turning down the providers first offer (with a total contribution lower than the anounced price) the provider, realizing his large element of "sunk cost", will be tempted to re-launch the good at a lower price after some period of time. Hence, if the provider decides to use a selling mechanism as suggested in Section 2 above it is crucial that his threat of not (ever) offering the good again, in case total contribution falls short of the anounced price, is preceived as credible by all users before they decide on their strategies. This may in fact prove to be one

of the major arguments in favor of the continuing existence of organizations like record companies, book publishers etc.

At first sight, attempts like the one of Stephen King to sell his own novel on the Web may appear as the end of book publishing companies. However, a publishing company may indeed offer the credibility needed to succesfully finance the writing of books. From the readers viewpoint it seems that the authors themselves are much more likely to be tempted to release their books again after some years – maybe under a different title and with a slightly changed text (it is difficult to check whether it is a new product as only the title and perhaps small samples of the old book has been announced previously). Hence, the motivation to contribute the true willingness to pay is strongly reduced as contributing less only implies that the user might risk to wait a little longer to obtain the good at a probably smaller price. Publishing companies, on the other hand, seem far more suited to build an image of credibilty as they can diversify their risks over a large series of products.

5 King's mechanism - what went wrong?

Returning to "The Plant" by Stephen King we shall now examine whether the mechanism proposed in Section 2 could have increased the likelihood of successful publishing on the Web.

As mentioned in the introduction the fact that the book was offered in chapters rather than as a complete novel introduced an unnecessary uncertainty among the potential readers: The readers had no estimate of the total number of chapters and thereby the price of the complete novel and moreover had no certainty of ever receiving it. These aspects strongly decrease the expected value of basically all chapters but the last and thereby readers are less willing to pay the announced "price". Consequently, it seems that any mechanism ought to reduce these kinds of uncertainties by offering the complete novel at once rather than in separate installments.

Moreover, following the mechanism introduced in Section 2, potential users should be allowed to express their individual valuations rather than be forced to pay a fixed unit price. To illustrate the problem: Assume that the potential readers are willing to pay $ 1.2 for three out of four installments or equivalently 90 cents for every installment. By announcing a fixed unit price of 1 dollar a cordination problem occurs between the potential readers since they have to coordinate who pays for which installments and when. Clearly, this coordination may easily fail as there is limited communication between readers. By letting readers pay their own valuation, that is 90 cents for every installment, such coordination problems are avoided.

Another important difference between King's mechanism and the mechanism of Section 2 is the fact that King's mechanism is based on the ratio between the number of paying readers and the number of downloading readers rather than just total payments. Indeed, potential readers with evaluations below 1 dollar decrease the likelihood of a successful selling in King's mechanism since they add to the number of downloading readers but not to the number of paying readers. Contrary to this, the mechanism in Section 2, where a fixed total price is announced, ensures that any reader who has positive willingness to pay and therefore makes a positive bid just adds to the chance of publication.

With respect to the discussion in Section 4, it should be noted that by making the first two chapters available for free potential readers were offered a chance to experience the quality and nature of the good. So the novel was treated as an experience good, something that should add to the chances for successful selling. Moreover, since the novel was not completed when the first installments were offered the sunk costs of Stephen King were reduced, making the threat of not publishing further chapters more credible. So for individual providers in general this seems to be a good strategy.

6 A field experiment

A large body of experimental research addresses in laboratory experiments the empirical validity of the free rider hypothesis utilizing various versions of voluntary contribution mechanisms as initiated by Marwell & Ames (1979, 1980, 1981) and surveyed in Ledyard (1995). While some research gives evidence for free riding (e.g. Haan & Kooreman (2002), Kim & Walker (1984)), others show that voluntary contribution mechanisms are capable of providing public goods even in large groups of users with complete information (e.g. Isaac & Walker (1988), Isaac, Walker & Williams (1994)) as well as with complete uncertainty in the sense that users only know their own valutions and nothing else (Rondeau, Schulze and Poe (1999)).

Furthermore, voluntary contribution mechanisms have been used in practice. Bagnoli and McKee (1991) reports on three successful applications (the public good was provided) in the US from 1979 to 1986, not to mentioned voluntary contributions to churches and benevolent organizations. Here, we provide a small field experiment (a test in a restricted natural setting, Davis and Holt (1993, p. 32)) to illustrate the mechanism proposed in Section 2 and supplement the laboratory experiments mentioned above.

One of the authors performed the following experiment in a graduate class on Allocation Mechanisms at the Institute of Economics, University of Copenhagen. Each week the lecturer was willing to supply (on the Web) a small written note (2-3 pages) discussing the subjects of the following week's lecture. The total price for supplying the note was DDK 40 (approx. $ 5) resulting in an average price per student of around DKK 48 (approx. $ 6) for a complete set of notes (approx. 30 pages). The notes were not written in advance.

Each week in twelve weeks students could make a voluntary contribution. The contributions should be given before thursday at 7:00 a.m. If the total sum of the contributions was greater than or equal to the price of DDK 40, then the note was placed on the lecturer's homepage free to download for everyone, friday at noon. Students had to pay their contributions the

following Tuesday. If the total sum of the contributions was below the price of DDK 40, no lecture note was made available (and no-one paid). Every Tuesday the students were informed of the total sum of contributions as well as the number of contributors.

It is worth noting that the number of users was uncertain as one should expect of any practical application and that the users had to pay their contributions in cash.

The first note (week no. 7) was free - to let the students expirence the good. There was only supplied one note in the weeks (15-16) because of the easter holidays. The outcome of the field experiment is shown in Table 1.

	Week no.											
User no.	8	9	10	11	12	13	14	15/16	17	18	19	20
1	7.00	4.00	3.75	-	3.50	3.25	3.00	2.75	4.00	4.00	4.00	4.00
2	8.00	5.00	5.00	-	5.00	-	5.00	-	5.00	6.00	6.00	6.00
3	9.00	6.00	5.00	4.75	7.00	6.00	6.00	6.00	7.00	8.00	6.00	7.00
4	6.00	5.00	4.01	-	5.00	5.00	4.00	0.00	0.00	0.00	0.00	-
5	3.00	3.25	5.00	4.35	7.25	6.25	5.50	5.00	5.75	5.25	5.50	5.25
6	5.25	5.00	4.00	4.00	6.00	6.00	6.00	5.00	7.00	10.25	10.00	10.00
7	6.00	5.00	4.50	4.25	-	3.00	3.00	3.00	-	-	-	3.00
8	6.00	5.50	5.00	4.50	5.00	5.00	4.50	4.00	-	4.50	4.50	4.50
9	5.35	5.00	4.50	4.35	-	4.50	4.50	4.25	5.00	6.00	6.50	5.50
10	-	5.00	5.00	5.00	5.00	5.00	4.50	4.50	5.00	5.00	5.00	5.00
sum	55.60	48.75	45.76	31.20	43.75	44.00	46.00	34.50	38.75	49.00	47.50	50.25

Table 1: *Individual contributions in 12 weeks*

Table 1 shows that in nine out of twelve weeks the students received the notes (that is, in 75 percent of the cases). In three weeks the sum of their contributions was less than DKK 40, and accordingly the lecture notes were not made available. In view of the fact that there were at most 10 persons participating a succes rate of 75 pct. is not surpricing. A limited number of users increase the likelihood of being pivotal for every user and therefore reduce the incentive to free ride. Especially considering that a limited number of users also makes the process very sensitive if some users are prevented from participating. For example, in two out of the three times the good was not provided since some people seem to have been prevented from participating (marked by -) due to various holidays. This emphasizes that marketing is still a very important issue for succesful selling - never launch a new product during holiday season.

Moreover, it may be noted that some participants radically change their willingness to pay along the process. For example, person no 7 discovers that the notes are worthless to him/her whereas person no 6 suddenly finds them very valuable. This reflects the problem concerning expirience goods which must be dealt with prior to the sale.

Finally, it appears that the students did not cooperate which would have been easy given the relatively small number of students. With more participants cooperative bidding will be even more rare.

7 Concluding remarks

As argued by several authors information goods essentially become public goods when they are digitalized. With public goods there are always incentives to free ride as witnessed by the many Internet sites where users freely swap files without paying royalties.

The present paper argues that providers of information goods should consider alternative ways of selling their goods rather than only focus on protecting their copy-rights. A particular mechanism is suggested and it is demonstrated that this mechanism solves the free rider problem provided that there is a sufficient level of information between users concerning their willingness to pay and/or there is a limited number of users. Indeed, if the provider as well as the users have complete information the mechanism results in first-order price discrimination (independent of the number of users).

However, for practical use there are always a certain degree of incompleteness in the information. Therefore, the provider cannot hope for first-order price discrimination but may accept some reduction in expected profits. Consequently, the provider should encourage any action that improves the level of information; support the formation of user-groups, fan-societies etc. Moreover, the provider must be aware that even minor practical details concerning the specific implementation of the mechanism may influence users' strategies and thereby become crucial for the specific design.

The mechanism suggested in the present paper has the advantage of being quite simple. More sophisticated mechanisms may very well lead to higher expected profit. However it is an open question whether markets in practice can be expected to function under such requirements.

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