

Torts in Open Contents*

(Incomplete draft)

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(The full paper is available here when the revision is completed:

<http://benjaminchiao.org/papers/opencontentstorts.pdf>)

Abstract

We extend traditional tort analyses by including value-adding resellers who do not need to pay the innovators (i.e. original sellers) for production. In some key open contents processes such as open source,

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downstream licensing is royalty-free but profits from other means derived from the software are allowed. Buyers, especially large vendors, can then become resellers to compete with the innovators. The innovators, however, can actually share the cost with the resellers to indemnify product and intellectual property infringement liabilities of the other downstream buyers and the innovators. Our theoretical results aim at establishing the optimal liabilities arrangements across agents. Together with some empirical tests, this research potentially paves a way to the question of who should use what licenses and instruments for what information goods. (Note: The empirical test using data on open content licenses is currently in progress.)

1 Introduction

The scope of open contents is defined here as copyrightable subject matter that is:

- observable by the public (not just fixed on a tangible medium)
- modifiable without reverse engineering in an unauthorized way, or without costly changes even for trivial changes¹

¹We do not necessarily require that the source code to be modifiable but the contents *licensed* (e.g. the source code if it's open source) to be modifiable. We do not rule out, for example, media files in which the source code that generates say a tree is not open for modification but the image of the tree is. Analog music satisfies modifiability if it can be converted cheaply to digital files for modification. However, we rule out, for example, binary software files without disclosing the source code. Disclosing the source code is not sufficient; one could release a photo of million lines of code—it is hard to insert even a single letter to make the code executable.

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- comprehensible to persons having ordinary skills in the trade^{2,3}
- without royalty for at least some form of redistribution, use and modification⁴

The open contents phenomenon potentially aggravates the problem of expropriation by blurring the delineation of rights. The sources and economic consequences of “expropriation” put forth in the literature vary. The incomplete contracting literature is along the line that consequences not fully specified in a contract reduce investment (Grossman and Hart [1986] and Hart and Moore [1990]). On the other hand, “expropriation” or more generally “externality” could be argued as merely disguises for the absence of the right to contract (Cheung [1970]), and thus the outcomes become efficient by subsequent contracting, which is feasible as long as property rights are clearly defined and transaction costs are low (Coase [1960]). In other words, the difficulty to commercialize new innovations due to overlapping intellectual property rights (Gallini [2002], Jaffe and Lerner [2004]) could be thought of as a situation in which transaction costs are high or property rights are unclear.

²This parallels some provision in patent law: “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” 35 U.S.C. Section 103 (2004).

³Obfuscated code could produce very meaningful output yet the code itself is not comprehensible, see http://en.wikipedia.org/wiki/Obfuscated_code.

⁴For example, the dual-licensing of MySQL, and some creative commons open contents do charge royalties for commercial use but not for non-commercial use.

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In some key open contents such as open source, creative-commons or Wikipedia-type contents, downstream licensing is royalty-free but profits from other means derived from the contents are allowed. Buyers, especially large vendors, can then become resellers to compete with the innovators (i.e., original sellers). On the other hand, large vendors, especially when there are spillover effects to their other markets, could indemnify some of the intellectual property infringements (e.g., from patent thickets) of the small innovators. This paper will primarily focus on the theory section, we extend a standard injurer-victim tort model into an innovator-vendor-user model to establish some optimal liabilities arrangements across agents. In the empirical section (which is incomplete as of this draft), we analyze the licensing terms in some open content licenses and “subsidiary arrangements” (i.e. licenses or contracts related to the open content licenses). We show what instruments are used by what types of licenses. This research potentially paves a way to understand the optimal instruments and their values used in what open content licences.

2 Theory

2.1 Setup

We model the decision problems of several active agents in the economy relevant to the open contents landscape: social planner, users, innovators, and value-adding vendors (resellers or redistributors). In addition, there are two

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inactive agents namely, Nature, and Hidden (a group of intellectual property owners, other than the innovators, who have engaged in intellectual property disputes in question). The inactive agents collect receipts from users, innovators, and value-adding vendors but whose actions are not explicitly modeled.

In the standard bilateral-care accident models (Landes and Posner [1987], Miceli [1997] and Shavell [1980]), the choice of care and level of activity are relevant. We extend such model into one which is a three-way care accident model. The care levels here refer to the efforts, measured in monetary amount, made to avoid some total expected damage paid to the inactive agents. The damages are categorized into two groups: product failures and intellectual property infringements. The damages are paid to Nature for the former and thus there are no warm-body winners after payments, and to Hidden for the latter and thus there are expropriations because by definition it is hard to enter into contractual arrangements with Hidden⁵. Let $k_v l_v, k_u \tilde{l}_u, k_i l_i$ be expenditure on care per unit of activity by a vendor, each of the n users, and an innovator, respectively. Note that we use a representative user, who consumes the total of all users, to represent the users' decision problem. The care level, l_u , the representative user chooses is n multiplied by the care level \tilde{l}_u chosen by an individual user. That is,

⁵Since Hidden is by definition hidden, there is no way to contract with them and thus they are absent in the model. This is not to say that there are no other intellectual property owners that you can contract with. For example, not all trolls are hidden if they jump out of the bush early and negotiate a contract with other agents.

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$l_u = \tilde{l}_u n$. Denote $D(l_v + l_i, l_u)$ the total expected damage per unit of activity, where $D_1 < 0, D_2 < 0, D_{11} > 0, D_{22} > 0, D_{12} > 0$, and $D_{21} > 0$. For simplicity, we assume that l_v and l_i are perfect substitutes. This is an innocuous assumption because the effort used to produce each unit of l_v and l_i can still be imperfect substitutes. The level of activity, Q , which is better termed as output in this context because it is the number of copies of the same information good distributed by the innovators and the vendors.

The liability for active actor j , s_j , is defined to be the fraction of D that j needs to pay no matter there is or is no damage ex post because D is in expected terms paid ex ante. In general, s_j is distributed according to some distribution f_j with the expected value of \bar{s}_j .

Let $v(Q)$ be the marginal consumption benefit for a representative user of the information good. There is diminishing marginal benefit because by assumption $v' < 0$ ⁶. Let $c_i(\cdot)$ be the total production cost of an innovator. R is the price paid to either the innovators or the vendors depending on whom the user obtains the copy of the same information good from.

⁶Some form of diminishing returns must kick in at some point to rule out infinite sales, which we do not observe in the real world. For simplicity, we have considered only cases in which diminishing marginal utility is consistent with the cases that either Q is already expected to be so large that there is no more positive network effects, or there is no intrinsic network effects. For future extensions, one could adopt the fulfilled expectation approaches in, for example, Katz and Shapiro (1985), such that v can be written as $v(Q, Q^e)$ with $v_1 < 0$ and $v_2 > 0$, where Q^e is the quantities *expected* to be sold. In an equilibrium, $Q = Q^e$. The derivative is positive wrt the second argument because there is positive network externalities effect. Assume also that $\lim_{Q \rightarrow \infty} v(Q, Q^e) = 0$, then there will not be infinite sales. It also follows that we have diminishing marginal value for large Q . Economides and Himmelberg (1995) have further shown that diminishing returns continue to hold for small Q under some restrictive conditions.

2.2 The Users' Problem

The problem for the users is assumed to be equal to the one solved by a representative user. Assume that there is only one piece of information good to be produced, which requires a fixed cost of F . Users then consume the q_i and q_v copies of this good from the innovators and the vendors, respectively. Note that in equilibrium,

$$q_v + q_i = Q \quad (1)$$

So the user buys a total of Q copies, and chooses a care level l_u to maximize:

$$U = \int_0^Q v(h)dh - Q[R + \bar{s}_u D(l_v + l_i, l_u)] - Qk_u l_u \quad (2)$$

where $\frac{\partial R}{\partial Q} = 0$ ⁷, and \bar{s}_u is the expected liability share of the users for the damage. The care level refers to the caution the user taken to ensure that the intellectual property rights are cleared, and that the information good is properly maintained and operated. FOCs⁸:

$$-\frac{\partial R}{\partial l_u} = \bar{s}_u D_{l_u} + k_u \quad (3)$$

$$v(Q) = R + \bar{s}_u D + k_u l_u \quad (4)$$

⁷It is a standard treatment to ignore the effects of the changes in total industry output on prices when the decision problem is focusing on the price taking behavior in a competitive environment.

⁸The Leibnitz formula is used to derive the result $\frac{d}{dQ} \int_0^Q v(h)dh = v(Q)$.

2.3 The Innovator's Problem

In this model, an information good is not serviceable unless it is properly documented and provided with customer support. For each copy sold by the innovator, a marginal cost of $c'_i(\cdot)$ will be incurred by the innovator. The total variable cost of production is $c_i(\cdot)$. In addition, the innovator also chooses a care level l_i , at a cost of k_i per copy reflected in Q (important, not q_i , because it's open content), to directly adjust the expected damage D . The marginal care cost increases with Q because the more copies circulated, the higher the chance that a bug or problem is experienced and that an intellectual property infringement is detected.

For simplicity, there is only one innovator who is selected from competition. Thus, the innovator makes zero profit. The problem for the innovator is to choose q_i and l_i to maximize:

$$\Pi_i \equiv q_i R - F - c_i(q_i) - Q \bar{s}_i D(l_v + l_i, l_u) - Q k_i l_i \quad (5)$$

where \bar{s}_i is the expected liability share of the innovator. FOCs:

$$q_i \frac{\partial R}{\partial l_i} = Q \bar{s}_i D_{l_v+l_i} + Q k_i \quad (6)$$

$$R = c'_i(q_i) + \bar{s}_i D + k_i l_i \quad (7)$$

Free entry implies zero profit:

$$q_i R = F + c_i(q_i) + Q\bar{s}_i D + Qk_i l_i \quad (8)$$

2.4 The Vendor's Problem

There is one vendor who is selected from competition. Thus, the vendor makes zero profit. The vendor incurs a cost $c_v(\cdot)$ to redistribute some copies of the good created by the innovator.

On the other hand, this vendor enjoys a net spillover benefits, $\omega(Q)$, of the stock of copies in the economy⁹. For example, the vendor might be selling a complementary product in another market or benefiting from the reputation of redistribution. It implies that even if $q_v = 0$, as long as $q_i > 0$, this vendor might find it beneficial to incur l_v , at a cost of k_v per copy reflected in Q , to adjust the expected damage D ¹⁰:

$$\Pi_v \equiv q_v R - c_v(q_v) + \omega(Q) - Q\bar{s}_v D(l_v + l_i, l_u) - Qk_v l_v \quad (9)$$

⁹Large corporations usually involve multiple markets that enjoy more spillover effects (a higher $\omega(Q)$) to their other markets. They are then willing to subsidize the production of open contents. For example, IBM researchers Capek et al (2005) write, “We also saw in Linux the possibility of having a unified operating system on our platform...A strategy [at IBM] was planned that allowed us to add value for our customers in the areas, [which were] clearly in the broad area of what is called middleware, and not in operating systems.”

¹⁰The recent debate (Boldrin and Levine [2002], Klein, Lerner, and Murphy [2002], and Romer [2002]) focuses on the necessity of intellectual property in face of the new sharing technologies such as Napster. We fill a gap in the debate by enlarging the scope of analysis to include information goods such as software files. The sharing of software allows resellers to help increase the quality of the software by, for example, sharing the efforts to fix software vulnerabilities.

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FOCs:

$$q_v \frac{\partial R}{\partial l_v} = Q \bar{s}_v D l_v + l_i + Q k_v \quad (10)$$

$$R + \omega'(Q) = c'_v(q_v) + \bar{s}_v D + k_v l_v \quad (11)$$

Free entry implies zero profit:

$$q_v R + \omega(Q) = c_v(q_v) + Q \bar{s}_v D + Q k_v l_v \quad (12)$$

2.5 The Decentralized Equilibrium

(1), (3), (6) and (10) together with the following three equations characterize the equilibrium given the liability rules. Since $\bar{s}_v + \bar{s}_u + \bar{s}_i = 1$, the equilibrium level q^+ is determined by the following equation, obtained from the combination of (4) and (7)¹¹:

$$v(Q) = c'_i(q_i) + (\bar{s}_u + \bar{s}_i)D + k_i l_i + k_u l_u \quad (13)$$

Also, the equilibrium level q_v^+ is determined by the following equation, obtained from the combination of (4) and (11)¹²:

$$v(Q) = -\omega'(Q) + c'_v(q_v) + (\bar{s}_u + \bar{s}_v)D + k_v l_v + k_u l_u \quad (14)$$

¹¹To be more precise, q_i^+ is still a best response function wrt q_v . But we do not need to explicitly solve for it for comparative statics.

¹²Similarly, q_v^+ is still a best response function wrt q_i .

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The shutdown decision is determined by the following equation, obtained from the zero-profit conditions (8) and (12):

$$R = \frac{-\omega(Q) + F + c_i(q_i) + c_v(q_v)}{Q} + \bar{s}_i D + \bar{s}_v D + k_i l_i + k_v l_v \quad (15)$$

2.6 The Centralized Equilibrium

The social planner's problem is to choose l_v, l_u, l_i, q_i and q_v to maximize the total welfare¹³:

$$W = U + \Pi_i + \Pi_v \quad (16)$$

$$= \int_0^Q v(h) dh + \omega(Q) - c_i(q_i) - c_v(q_v) - Q(k_v l_v + k_u l_u + k_i l_i + D) \quad (17)$$

¹³In this basic model, the social planner does not care about the welfare of Hidden. One could extend this model by multiplying D with θ , where $1-\theta$ is the share of damage related to the intellectual property infringements paid to Hidden. θ could also be a variable for the social planner to choose at a certain cost for the optimal value.

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FOCs:

$$k_v + D_{l_v+l_i} = 0 \quad (18)$$

$$k_u + D_{l_u} = 0 \quad (19)$$

$$k_i + D_{l_v+l_i} = 0 \quad (20)$$

$$v(Q) = -\omega'(Q) + c'_i(q_i) + k_v l_v + k_u l_u + k_i l_i + D \quad (21)$$

$$v(Q) = -\omega'(Q) + c'_v(q_v) + k_v l_v + k_u l_u + k_i l_i + D \quad (22)$$

These five first-order conditions determine $l_v^*, l_u^*, l_i^*, q_i^*$ and q_v^* , respectively.

These are defined to be the socially efficient levels of each variable.

2.7 Comparative Statics

Efficiency is defined to be achieved if the values of the decentralized and centralized equilibrium variables (denoted by + and *) coincide.

2.7.1 No Bargaining

We impose several restrictions here:

$$\bar{s}_v, \bar{s}_u, \bar{s}_i \in [0, 1] \quad (23)$$

$$\bar{s}_v + \bar{s}_u + \bar{s}_i = 1 \quad (24)$$

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and

$$\frac{\partial R}{\partial l_v} = \frac{\partial R}{\partial l_u} = \frac{\partial R}{\partial l_i} = 0 \quad (25)$$

so the price is independent of l_v, l_u and l_i .

The lower bound of the first restriction says that one cannot take the liabilities as a revenue source. Its upper bound implies that one cannot pay more than what the damage is worth. The second restriction ensures that the damage is not dissipative—the relevant actors must together be responsible for the whole damage. The third restriction says that the care level will not be compensated for through the sales revenue.

Relaxing each of these opens up room for bargaining. For now, we first look at the benchmark case of no bargainings.

Quantities One implication of the following proposition says that to have efficient quantities produced, vendors (but not innovators) should bear positive liability when the marginal spillover effect $\omega'(Q)$ is high relative to its marginal care cost k_v .

Proposition 1 *Given some strictly positive care levels, the liability rules are irrelevant for q_i^* and q_v^* . But the efficient quantities levels of q_i^* and q_v^* are not necessarily obtained from the decentralized equilibrium. In fact, $q_i^* = q_i^+$ if and only if $\bar{s}_v = \frac{\omega'(Q) - k_v l_v}{D} \geq 0$ and $q_v^* = q_v^+$ if and only if $\bar{s}_i = 0$.*

Proof. \bar{s}_v, \bar{s}_u , and \bar{s}_i are absent in (21) and (22). (21) differs from (13) because of the extra terms $-\omega'(Q) + k_v l_v + \bar{s}_v D$ in (21). Whether q_i^* is

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greater or less than q_i^+ depends on whether the extra terms sum to a positive or negative amount. In fact, $q_i^* = q_i^+$ if and only if the extra terms sum to zero, which means

$$\bar{s}_v = \frac{\omega'(Q) - k_v l_v}{D}, \quad (26)$$

which is restricted to be non-negative. Also, (22) differs from (14) because of the extra terms $k_i l_i + \bar{s}_i D$ in (22). Again, whether q_v^* is greater or less than q_v^+ depends on whether the extra terms sum to a positive or negative amount. In fact, $q_v^* = q_v^+$ if and only if the extra terms sum to zero, which means

$$\bar{s}_i = \frac{-k_i l_i}{D}, \quad (27)$$

which violates the non-negative constraint unless $\bar{s}_i = 0$. ■

The intuition is that if $\bar{s}_v \neq \frac{\omega'(Q) - k_v l_v}{D}$, the innovator does not take into account the spillover effect to the vendor and free rides on the vendor's share of damages and the care level exercised by the vendor. When the innovator is not liable ($\bar{s}_i = 0$), the vendor cannot free ride on the innovator's share of damages and the care level exercised by the innovator.

Care Levels Now, let us compare the care levels by comparing the equilibrium care levels l_v^+, l_u^+ , and l_i^+ determined by (10), (3), and (6) with l_v^*, l_u^* and l_i^* determined by (18), (19), and (20).

Proposition 2 *Efficient care levels cannot be simultaneously achieved by*

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either strict liability ($\bar{s}_u = 0$) or no liability ($\bar{s}_u = 1$)¹⁴.

Proof. Since $\frac{\partial R}{\partial l_v} = \frac{\partial R}{\partial l_u} = \frac{\partial R}{\partial l_i} = 0$, for $Q > 0$, (10), (3) and (6) become:

$$k_v + \bar{s}_v D_{l_v+l_i} = 0 \quad (28)$$

$$k_u + \bar{s}_u D_{l_u} = 0 \quad (29)$$

$$k_i + \bar{s}_i D_{l_v+l_i} = 0 \quad (30)$$

By equating (18) with (28):

$$\begin{aligned} k_v + D_{l_v+l_i} &= k_v + \bar{s}_v D_{l_v+l_i} \\ \bar{s}_v &= 1 \end{aligned} \quad (31)$$

So the efficient level l_v^* can be obtained by strict liability to the vendor ($\bar{s}_v = 1$). Similarly, equating (20) with (30) to get:

$$\begin{aligned} k_i + D_{l_v+l_i} &= k_i + \bar{s}_i D_{l_v+l_i} \\ \bar{s}_i &= 1 \end{aligned} \quad (32)$$

So the efficient level l_i^* can be obtained by strict liability to the innovator ($\bar{s}_i = 1$). But $\bar{s}_i = 1$ contradicts with $\bar{s}_v = 1$ above if we restrict $\bar{s}_v + \bar{s}_u + \bar{s}_i = 1$

¹⁴For convenience, we term this as strict liability, which is from the perspective of assuming the user as the victim. This is merely rhetorical and does not change the substance of the mathematical results if other actors are named as victims.

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and each liability share to be positive. Now, equating (19) with (29) to get:

$$k_u + D l_u = k_u + \bar{s}_u D l_u \quad (33)$$

This implies that the efficient care level l_u^* can be induced by adopting the no liability rule ($\bar{s}_u = 1$). That is, there is no liability to the innovator and the vendor, which contradicts with both $\bar{s}_v = 1$ and $\bar{s}_i = 1$. There is still a contradiction even if we relax the unity conditions on \bar{s}_v and \bar{s}_i because together with $\bar{s}_u = 1$, $\bar{s}_v + \bar{s}_u + \bar{s}_i = 1$ cannot be satisfied. ■

2.7.2 Coasean Bargaining

Quantities

Proposition 3 *The efficient quantities can be restored through bargaining such that the marginal spillover effect completely offsets the total marginal care cost of the innovators and vendors and/or the liability share of the user. That is, $\omega'(Q) = k_v l_v + k_i l_i$.*

Proof. In a model with only users and innovators where they can bargain at low cost, Landes and Posner (1985, 1987) show that even strict and no liabilities can lead to efficient care levels with bargaining and efficient quantity with and without bargaining. In our model, quantities are efficient ($q_i^* = q_i^+$ and $q_v^* = q_v^+$) if and only if the following holds:

$$\frac{\omega'(Q) - k_v l_v}{D} + \bar{s}_u + \frac{-k_i l_i}{D} = 1, \quad (34)$$

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which is a combination of $\bar{s}_v + \bar{s}_u + \bar{s}_i = 1$, and the relaxation of non-negativity constraint of each liability share such that equations (26) and (27) hold. One form of bargaining arises from the liabilities taking also negative values.

First consider the no liability case. $\bar{s}_u = 1$ implies that (34) holds when $\frac{\omega'(Q) - k_v l_v - k_i l_i}{D} = 0$ or $\omega'(Q) = k_v l_v + k_i l_i$. That is, the marginal spillover effect completely offsets the marginal care costs of the innovator and vendor (not the user's). In this case, quantities q_i^+ and q_v^+ are efficient when the liability shares \bar{s}_v and \bar{s}_i are bargained between the innovator and vendor to the point where $\frac{\omega'(Q) - k_v l_v - k_i l_i}{D} = \varphi = 0$. That is, for $\bar{s}_v + \bar{s}_i = 0$ to hold, the proceeds derived from $\bar{s}_v = \frac{\omega'(Q) - k_v l_v}{D}$ must be completely transferred to the innovator. More generally, when $\varphi \neq 0$, φ can be adjusted also through the bargaining with the user such that s_u is adjusted accordingly to satisfy (34). Strict liability ($\bar{s}_u = 0$) is the special case when $\varphi = 1$. ■

Care Levels

Proposition 4 *In the no liability case ($\bar{s}_u = 1$), for non-trivial quantity produced, efficient care levels can be achieved by reimbursing the care costs of the innovator, the vendor, or both.*

Proof. In the no liability case ($\bar{s}_u = 1$), l_u is efficient because of (33). Now, we will show that other care levels can also be efficient from bargaining through R, q_i, q_v, k_i and k_v . From (4) with $\bar{s}_u = 1$, we know that the maximum that the users would pay is $R = v(Q) - D - l_u$. Taking derivatives, we have $\frac{\partial R}{\partial l_v} = \frac{\partial R}{\partial l_i} = -D_{l_v + l_i} > 0$. That means the user pays more to compensate for

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the care efforts made. After substitution: 1) (10) becomes $Qk_v + q_v D_{l_v+l_i} = 0$. It is equal to (18), which determines the efficient l_v , if i) $q_i = 0$, or ii) both k_v and $D_{l_v+l_i}$ equal to 0; 2) (6) becomes $Qk_i + q_i D_{l_v+l_i} = 0$. It is equal to (20), which determines the efficient l_i , if iii) $q_v = 0$, or iv) both k_i and $D_{l_v+l_i}$ equal to 0. Both i) and iii) happen is an uninteresting scenario in which $Q = 0$. But when $Q > 0$ (i.e., either i), iii) or both does not happen), one could bargain to the efficient care levels such that either ii), iv) or both are satisfied, respectively. Note that in such cases, $l_v + l_i$ should be bargained to the level that $D_{l_v+l_i} = 0$ because either k_i or $k_v = 0$ leads to $D_{l_v+l_i} = 0$ in (20) and (18), respectively. Note that the relative magnitudes of k_v and k_i determine whether the innovator or the vendor will be the one who exercises the care (other than the user) because l_v and l_i are perfect substitutes. ■

In other words, the Coase Theorem is delivered on a silver plate when there are further bargaining arrangement such that the respective cost of care level is zero for either the innovator or the vendor or both, and that the optimal collective care levels of l_v and l_i are induced. Similarly, other bargaining arrangement can be proven for other values of \bar{s}_u .

3 Empirical Findings (Incomplete)

If our model is a reasonable approximation to the real world, especially in the sense that the transaction cost is low to use the instruments (e.g. liability shares, care levels/costs, sales revenues, quantities) in Propositions 3 and 4

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to bargain, the Coase theorem says the values of the instruments we observe in the real world should be socially optimal.

One challenge of the empirical study is to observe the values chosen in the real world. Sometimes such values are explicitly mentioned in the licences. Else, values are bargained between agents privately, being pledged or decided by individuals without using an explicit bargaining process other than the market itself. Even if such observation is perfect, we cannot immediately conclude that the real world values are not optimal when there is a deviation from the theoretical values because the transaction costs associated with one or more instruments could simply be too high. Therefore, as of this preliminary draft, we pursue a less ambitious agenda to find out what common instruments are used by what types of licenses. This could inform future theoretical studies about what instruments to incorporate in a model if one is to pursue a closer mapping of theory to data. Even if the instruments are not commonly used now, our study suggests the use of them when the associated transaction costs decrease. This research potentially paves a way to the question of who should use what licenses and instruments for what information goods.

From causal observations, there is a clear pattern emerging. The no liability rule, as predicted in theory, is gradually being replaced by indemnification arrangements such as UCITA, open source patent pools, safe harbor provisions, code pedigree control, etc. In this section, we want to further substantiate it with empirical data. We primarily focus on the licensing

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terms in the open content licenses because they are publicly available and themselves some manifestation of market aggregation due to the elaborate drafting process in some cases. We also analyze some instruments used in what we called the “subsidiary arrangements” (i.e. licenses, contracts, or pledges related to the open content licenses).

3.1 Methodology (Incomplete)

We largely use the lists of open content licenses discussed in Newmarch (2000) and Liang (2004). Our list is still not comprehensive but contains a mixture of over two dozen key licenses. (Note: The updated version of this paper will contain more licenses, which should justify an upcoming econometric study because of increased statistical significance.)

We analyze the terms of each license and code what instruments are used. In practice, we employ one or more proxies of each instrument.

3.1.1 Empirical Tests (Incomplete)

To be completed.

4 Conclusions

We extend traditional tort analyses in one key direction—the inclusion of value-adding resellers (vendors) who do not need to pay the original sellers (innovators) for production. In our model, the ubiquitous but vague term

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“expropriation” is given a precise definition: payments to people one cannot contract with.

We first show that efficient care levels cannot be simultaneously achieved by either strict liability or no liability to users. We further analyze how bargaining can achieve social efficient output and care levels. The efficient quantities can be restored through formal or informal bargaining such that the marginal spillover effect completely offsets the total marginal care cost of the innovators and vendors and/or the liability share of the user. In the no liability to user case commonly used in open content licenses, efficient care levels can be achieved by reimbursing the care costs of the innovators, the vendors, or both.

In the empirical section (which is incomplete as of this draft), we plan to analyze the licensing terms in some open content licenses and “subsidiary arrangements” (i.e. licenses or contracts related to the open content licenses). We plan to show what instruments are used by what types of licenses. This research potentially paves a way to the question of who should use what licenses and instruments for what information goods. We also plan to substantiate the extent to which the no liability to user rule, as predicted in theory, is gradually being replaced with indemnification arrangements such as UCITA, open source patent pools, safe harbor provisions, code pedigree control, and the like.

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