PROPERTY RIGHTS IN STOLEN GOODS: AN ECONOMIC ANALYSIS

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ABSTRACT

Who should get the title to a stolen and recovered good -- the original owner or the innocent buyer who purchased it in good faith and can no longer recover from the seller-thief? This paper examines the effects of alternative priority rules on theft-related activities. The paper develops a formal economic model to examine four possible priority rules: a rule that grants unconditional priority to the original owner, a rule that grants unconditional priority to the buyer, a rule that conditions the owner's priority on non-negligent protection of the asset prior to the theft, and a rule that conditions the buyer's priority on good faith purchasing behavior. These rules are compared with respect to the incentives they generate for owners to protect property, for thieves to steal, and for parties to recover stolen goods, as well as with respect to the overall frequency of theft. It is argued that priority rules can be designed to induce socially desirable levels of private precaution against theft.

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I. INTRODUCTION

An asset is stolen from its owner and sold to an innocent buyer. Who should retain the legal title for the asset, the original owner or the innocent buyer?

This problem has perplexed legal scholars for generations. Both the owner and the buyer appear to have a legitimate claim, and when the thief is judgement-proof, the law must decide how to allocate the asset among the two claimants. The absence of an intuitive, fairness-based resolution of the conflict has led legal systems to incorporate various different rules.[1]

Under the traditional common law rule, the original owner of the asset can repossess it and overcome the buyer's claim. Founded on the doctrine that the thief cannot convey such title as he himself did not possess ("he who hath not cannot give"), the buyer is stripped of any rights in the asset, even if he were innocent.[2] It also generally applies nowadays in the U.S.[3] Other legal traditions afford greater protection to innocent buyers. Founded on the notion that "in the case of movables, possession is equivalent to title", most Continental European jurisdictions permit the buyer to retain title (or, at least, to be

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[1] See Levmore [1987].

[2] In England, see *Whistler v. Forster* (1863) 14 C.B. (N.S.) 248, 257; Sales Goods Act §21(1), 1979. This approach was also prevalent in ancient law. See Murray [1960].

[3] See, e.g., *Allstate Insurance Co. v. Estes*, 345 So.2d 265 (Miss. 1977); *Schrier v. Home Indemnity Co.*, 273 A.2d 248 (D.C. App.1971). See also Schwartz and Scott [1991], p. 501. §2-403 of the Uniform Commercial Code, which establishes a superior status for a buyer who satisfies strict conditions of good faith, generally does not apply in cases of theft. See Mautner [1991].

compensated by the owner), provided that the purchase was made in good faith.[4] In some countries, the owner's position against the buyer depends crucially on the owner's "fault" in creating this conflict. In the case of theft, however, the owner is usually not deemed at fault, even if she took less than adequate precaution; hence, she is often perceived as having the superior claim.[5]

This paper offers an economic analysis of the problem. It examines how alternative priority rules affect the parties' incentives to engage in theft-related activities. It is motivated by the basic insight that while theft is *not* a social cost per se, it increases transaction costs in the transfer of property relative to other modes of transfer by imposing huge costs on individuals, in particular on potential victims who invest in protection measures.[6] One way the legal system can influence these expenditures is through the allocation of property rights in stolen goods and, in particular, through the resolution of the conflict between the original owner and the innocent buyer.[7] Specifically, the paper focuses on the effects of the legal rules on property owners' incentives to protect their assets before theft occurs, and to search and trace their assets after theft occurs, and on

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[4] Examples are: Article 932(2) of the German Civil Code; Article 1153 of the Italian Civil Code (1942); Articles 2279-80 of the French Code Civile. See Murray [1960].

[5] This is the situation in England. See §64(1) of the Criminal Justice Act 1972; *Jerome v. Bentley & Co.*, [1952] 2 All.E.R. 114, 118. In France, see §2279 of the Civil Code.

[6] One study estimated private and business expenditures in the U.S. on guards and locks to have exceeded $160 billion in one year (1985). See Leband and Sophocleus [1992]. Philipson and Posner [1996] quote the figure of $300 billion annual spending on private protection against all types of crime.

[7] Another way is by making the sanction on the thief dependant on the protection measures employed by his victim. See discussion in the Concluding Remarks.

thieves' incentives to engage in theft. Understanding these incentives can help in determining the overall degree of theft under alternative priority rules.

By focusing on the theft-related activities of the property rules, this paper deviates from a standard text-book approach to this issue. Commonly, authors highlight the effects of the priority rules on parties involved in *trade* of property. Based on the premise that buyers are cautious in the face of the risk of buying stolen goods, writers have argued that offering protection for bona fide purchasers would enhance the smooth operation of markets.[8] This is the leading rationale for the English "market overt" doctrine.[9] It is not clear, however, that transaction costs surrounding trade are truly dependant on the priority rule. If the fraction of stolen assets is small relative to volume of trade or if most transactions pass though reputable traders, there is little buyers would *want* to do to investigate an asset's history prior to the purchase. Furthermore, if assets are not unique or identifiable, there is little buyers *can* do to investigate the history. Thus, on the assumption that the priority rules affect owners' actions more than buyers', the focus of the analysis is on how the rules influence owners' incentives.[10]

The analysis develops a formal model which captures three stages in the "life" of a

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[8] See, e.g., Gilmore [1954]; Hawkland [1962], p. 700; Brown [1975], p. 1935; Schwartz and Scott [1991], p. 509-510.

[9] See Sales Goods Act §22 (1979); Murray [1960].

[10] Previous economic treatments of the issue of property rights in stolen goods have focused also on another aspect of transaction costs -- buyers' information costs when purchasing assets. See Levmore [1987], Schwartz and Scott [1991]. An informal economic study focusing on theft-related activities appears in Weinberg [1980] and Shavell [1995]. A formal model examining both theft-related activities and tradeability factors appears in the independent work of Landes and Posner [1996].

stolen asset. The first stage is the theft stage, during which costs are incurred by owners to protect their assets, and efforts are invested by thieves to accomplish a successful theft. If theft occurred, at the second stage a transaction may take place between the thief and a buyer, who may or may not be aware of the asset's source. Real costs may be incurred at this stage as well, particularly by the buyer in attempt to verify ownership. However, as the buyer's incentives at this stage have been previously examined by the law-and-economics literature, the model in this paper abstracts from them. The third stage is the enforcement stage, during which the original owner -- or an agency on her behalf -- incurs search costs in an effort to retrieve the asset.

The parties' investments in theft-related activities are examined under four possible legal regimes. The first two are polar regimes: one which assigns unconditional priority to the buyer and another which assigns unconditional priority to the owner. The other two regimes grant conditional priority: the buyer-in-good-faith regime, which gives the buyer a priority if the asset were purchased without knowledge of the theft; and the owner's negligence regime, which gives the owner a priority if the asset were adequately protected.

The paper is structured as follows. Section II presents the framework of the analysis. Section III examines the incentives under the rule which grants unconditional priority to the buyer. Section IV examines the incentives under the buyer in good faith rule. Section V examines the incentives under the rule which grants unconditional priority to the original owner, and Section VI examines the incentives under the owner's negligence rule. Section VII then combines the results of the analyses of the four rules and offers five Propositions that compare the various incentives and the amount of theft arising

under the four rules. As most of the results and intuition are presented in Section VII, the reader may skip the technical analysis in Sections III-VI. Section VIII offers concluding remarks.

II. The Framework of Analysis

An owner holds a tangible asset, which may be stolen from her by a thief. If stolen, the thief may sell it to a buyer. It is assumed that the owner and the buyer value the asset in identical fashion, in an amount denoted by v. The thief assigns no value to the asset other than its resale value.[11]

The timing of the model is as follows. Originally (time 0) the owner produces the asset. Then, during the first period, the "theft stage", the thief makes an attempt to steal the asset and the owner protects it. The success of the attempt depends on the owner's investment in protection against theft and on the thief's effort to steal. Denote by $x \geq 0$ the owner's cost of investment in protection and by $y \geq 0$ the thief's cost of effort to steal. Let $t(x,y)$ denote the probability of a successful theft, with $t(x,0) = 0$ for all x, $t_x < 0$ and $t_{xx} > 0$ whenever $y > 0$, $t_y > 0$ and $t_{yy} < 0$ -- i.e., positive but decreasing marginal returns to each party's efforts. In addition, assume that $t_{xy} < 0$ -- i.e., effort to steal is less productive the more protected is the owner, or, correspondingly, protection is more productive against higher efforts to steal. Lastly, assume that $t_x(0,y) = \infty$ whenever $y > 0$ -- i.e., some level of

[11] By setting the valuations of the owner and the buyer to be equal, at the level v, this framework facilitates exclusive focus on involuntary transfers of property. Voluntary transfers between the owner and the buyer could potentially take place only if the parties' valuations differ. In such a case, one may examine the effects of theft and other interfering activities on parties' incentives to make or refrain from making efficient transfers.

protection is always valuable to the owner.

If the theft attempt fails, no more interactions take place. If, however, theft occurs, the second period in the model -- the "transaction stage" -- takes place. During this period, the asset may be sold to the buyer. The transaction stage is modelled as a bargaining round, which starts with the buyer observing a signal on whether the asset is stolen. Specifically, the buyer will know that the asset is stolen with probability θ and will perceive it as not stolen with probability 1-θ. What the buyer knows is determined randomly and exogenously,[12] and it is known to the thief and verifiable in courts. Knowing what the buyer knows, the thief makes a take-it-or-leave-it offer to sell the asset for a price of p. The buyer can either accept or reject the thief's offer. If the buyer rejects the offer, a sale does not take place, the thief destroys the asset and no more interactions ensue in the transaction stage.[13]

After the transaction stage, the third and last period in the model -- the "search stage" -- takes place. During this period, the owner (or some "agency" on her behalf -- police, private investigators) expends effort in tracing the stolen asset. Let z denote the search cost, and let $r(z)$ denote the probability that, conditional on the asset being sold to the buyer, the asset will be traced (with $r(0) = 0$, $r' > 0$, $r'' < 0$).

It is assumed throughout that all parties are risk-neutral and know the model

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[12] The possibility that the buyer's knowledge is determined endogenously will be discussed.

[13] This assumption merely reflects the fact that the thief does not gain utility from the stolen asset itself and that theft is conducted strictly for its trade benefits. See Weinberg [1980], pp. 571-574.

perfectly. The focus of the analysis is on how the law should resolve the contest between the owner and the buyer, in situations in which the owner traces the stolen asset to the buyer's possession and the thief is judgment-proof. In such situations, both the owner and the buyer have a claim to the asset, but only one of them can legally own it. Who should be assigned the property right? Four possible resolutions of the conflict between the owner and the buyer will be examined:

(1) *Favoring the Buyer* (FB) - the buyer gets the asset regardless of whether, at the time of the transaction, the buyer knew the asset to be stolen.

(2) *Buyer in Good Faith* (GF) - the buyer gets the asset only if she bought it in good faith -- that is, without knowing it was stolen.

(3) *Favoring the Owner* (FO) - the owner gets the asset, no matter what were the circumstances surrounding the theft or the sale.

(4) *Owner's Negligence* (ON) - the owner gets the asset if her investment in protection of the asset satisfied the threshold "due level".

III. FAVORING THE BUYER

Under this regime, the buyer's claim to the asset she purchased from the thief will defeat the owner's claim, regardless of the buyer's knowledge concerning the true ownership of the asset or the owner's precaution against, and search after, the theft.[14]

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[14] This regime is not found in practice and is examined as a benchmark case. In reality, some market overt regimes are effectively close to an unconditional priority to buyers, when they incorporate lenient requirements of "ordinary course of business", and deem most transactions to satisfy them.

The following observations are straightforward: First, the owner will not make any investment in search of the asset, since this search can yield no gain: even if the asset is traced, the legal rule will not let the owner repossess the asset. Thus, $z^{FB} = 0$ (where the *FB* superscript denotes the *Favoring the Buyer* regime). Second, the maximal price the buyer will be willing to pay at the transaction stage will not depend on the buyer's knowledge of whether the asset is stolen. The buyer will be willing to pay a price up to v even if she receives a signal that the asset is stolen. Thus, the thief will offer a price $p^{FB} = v$, the buyer will accept it, and the transaction will take place.

In protecting her asset, the owner solves the following problem:

$$Min_x \; t(x,y)v + x \tag{1}$$

Simultaneously,[15] the thief chooses y to solve:

$$Max_y \; t(x,y)v - y \tag{2}$$

Expressions (1) and (2) together determine x and y. There may be either an interior or a corner solution. The interior solution, denoted by x^{FB}, y^{FB}, in which both levels of x and y are positive, can be solved from the following two first-order conditions:

$$-t_x(x^{FB},y^{FB})v = 1 \tag{3}$$

$$t_y(x^{FB},y^{FB})v = 1 \tag{4}$$

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[15] It is assumed that the thief and the owner choose x and y without observing each other's choices. We will comment later on alternative assumptions. The model also abstract from the deterrent effects of public enforcement, and examines only the effect of private protection on the thief's incentives.

Since this solution satisfies $y^{FB} > 0$ -- that is, some effort to steal is actually invested -- classify it as a "theft-accommodating" equilibrium. Alternatively, there may be a corner solution in which precaution deter theft altogether, that is, $y = 0$. This occurs if the interior solution yields a negative payoff for the thief, i.e., if

$$t(x^{FB},y^{FB})v - y^{FB} < 0. \tag{5}$$

The thief is then better-off refraining from theft (investing 0). If a "theft-deterring" equilibrium arises, the owner will invest in it less than x^{FB} in protection. The owner will choose $\bar{x}^{FB}$, the least costly theft-deterring level of precaution, which is the lowest x satisfying the constraint:

$$t(\bar{x}^{FB},y)v - y \leq 0 \quad \forall\, y \tag{6}$$

An example is a homeowner building only external preventive measures (fences, guards), sufficient to deter home entry, and no interior measures (safes, alarms, dogs).[16]

Graphically, let $\hat{x}(y)$ be the reaction curve of the owner, that is, the optimal protection level given any theft effort of y. It is upward-sloping because the greater the theft effort, the more productive protection becomes ($t_{xy} < 0$).[17] Let $\hat{y}(x)$ be the reaction curve of the thief, depicting the thief's optimal theft effort given any protection level of x.

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[16] The other corner solution in which $x = 0$ is not feasible, since we assume that $t_x(0,y)=\infty, \ \forall\, y>0$.

[17] Differentiating the first order condition of the owner's problem (expression (3)) yields
$d\hat{x}(y)/dy = -t_{xy}/t_{xx} > 0$.

It is downward-sloping for all $x \leq \bar{x}^{FB}$ because the greater the protection level, the less productive the theft effort.[18] However, $\hat{y}(x)$ displays a discontinuity at $\bar{x}^{FB}$, the level at which positive expenditures on theft are no longer individually rational for the thief. Figure I displays the interaction between the owner and the thief.

Insert Figure I here

In sum:

Under the Favoring the Buyer regime, the thief spends y^{FB} if (5) holds, 0 otherwise; the owner spends x^{FB} on protection of (5) holds, $\bar{x}^{FB}$ otherwise, and $z^{FB} = 0$ if theft occurs.

REMARKS: (i) *Theft Deterrence versus Theft Accommodation*. The theft-deterring solution is socially preferable to the theft-accommodating solution, as it involves lower levels of x and y and zero probability of theft. A corner solution becomes more plausible if, other things equal, protection measures are more effective than theft effort (that is, when the probability of theft is relatively more sensitive to x than to y.) That is, for a home owner to build an "impenetrable fortress" it must be that protection is effectively cheaper than theft measures.

(ii) *Bargaining Power at Transaction Stage*. If bargaining power at the transaction stage is more equally divided, then the price the thief can extract will be less than v, yet still independent of the buyer's knowledge. However, a lower price would diminish the thief's incentives to steal, a shift of $\hat{y}(x)$ downwards, and a new equilibrium with lower

[18] Differentiating the first order condition of the thief's problem (expression (4)) yields $d\hat{y}(x)/dx = -t_{xy}/t_{yy} < 0$.

levels of x and y. This does not imply that there will be less theft (since x declines as well), but it does imply that there will be less overall criminal and precautionary activity surrounding theft.

(iii) *The Effect of the Asset's Value*. As v grows larger, both the thief's and the owner's incentives to invest at the theft stage increase. The thief's incentives are increased due to the greater price he can extract from the buyer, and the owner's incentives are increased due to the greater expected loss that theft imposes on her. Thus, both reaction curves $\hat{x}(y)$ and $\hat{y}(x)$ shift outward, leading to a new equilibrium in which x rises unambiguously, but in which the effect on y is ambiguous. That is, the owner will unambiguously invest more in x for two reasons: her asset is more valuable to protect and she needs to combat the thief's increased incentives to steal. The thief's choice of y, on the other hand, has two opposing factors affecting it: the higher v leads him to invest more in theft effort, but the higher x leads him to invest less (from the assumption that $t_{xy} < 0$). Two implications can be asserted. First, theft may turn out to be more frequent when objects with *lesser* value are involved. Second, as the value of the property increases, a theft-deterring equilibrium is more difficult to achieve. As v rises, more protection by the owner is required to satisfy the theft-deterring condition.

(iv) *Sequential Choices at the Theft Stage*. It may be assumed that the owner and the thief act sequentially. Initially, the owner sets x, and the thief chooses y *after* observing the level of x. Formally, the owner will set a level of x that solves her minimization problem (1) subject to the constraint that the thief reacts optimally. That is, the owner chooses her cost-minimizing point on the thief's reaction curve. This is the "Stackelberg"

equilibrium depicted in Figure II. In this case the owner is no worse-off than in the simultaneous moves case (as she can always choose the Nash equilibrium pair (x^{FB},y^{FB})).

Insert Figure II here

IV. BUYER IN GOOD FAITH

Under the Buyer in Good Faith regime, the buyer is granted the priority right if and only if the buyer did not know, at the time of sale, that the asset is stolen. If the buyer purchases the asset knowing that it is stolen, the owner may repossess her asset from the buyer. Notice that within this model, the buyer either knows for certain that the asset is stolen, or perceives it not to be stolen, but does not act under uncertainty.[19]

Using backward induction, begin by analyzing the owner's search incentives. The owner expects that if she searches and finds the asset, she will be able to repossess it with probability θ, the case in which the buyer purchased it knowing it was stolen.[20] The owner sets z to solve:

$$\text{Max}_z \quad \theta r(z)v - z \tag{7}$$

The owner's optimal search, z^{GF}, satisfies the first order condition:

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[19] In an analysis that focuses on the buyer's incentives, the buyer can suspect -- but be uncertain -- that the asset is stolen. Within such a framework, one can introduce a distinction between a buyer that acts in "bad faith" (when he knows cognitively that the asset is stolen) and a buyer that acts "negligently" (when he does not devote adequate effort to verify his suspicions). See Landes and Posner [1996].

[20] This assumes that the owner expects that the buyer will purchase regardless of the signal she receives. This assumption will be consistent with the analysis of the buyer's purchasing decision below.

$$r'(z^{GF})\theta v = 1. \tag{8}$$

Moving backwards one stage, at the transaction stage the buyer will be willing to pay a price which is dependant on the information about true ownership. If the signal that the buyer receives is that the asset is stolen, the buyer discounts its value by the likelihood that the owner will find it and repossess it, hence the maximal price the buyer would be willing to pay is the net valuation of $(1 - r(z^{GF})v$. Alternatively, if the buyer receives the signal that the asset is not stolen and thus purchases it with good faith, the buyer expects to overcome the owner's claim. In this case, the maximal price the buyer would be willing to pay is v.[21] The thief will therefore offer either $p = (1 - r(z^{GF})v$ or $p = v$, depending on the signal the thief knows the buyer to observe, and the buyer will accept the offer.

At the theft stage, before the thief knows the actual signal the buyer will have, but knowing θ, the thief's expected return from a successful theft is $[\theta(1 - r(z^{GF})) + (1-\theta)]v$, or $[1 - \theta r(z^{GF})]v$. Thus, the thief and the owner set level of efforts that solve:

$$Min_x\ x + t(x,y)[v(1 - \theta\, r(z^{GF})) + z^{GF}] \tag{9}$$

$$Max_y\ t(x,y)[1- \theta r(z^{GF})]v - y \tag{10}$$

The interior solution, (x^{FG},y^{GF}), is characterized by the first order conditions:

$$-t_x(x^{GF},y^{GF})[v(1 - \theta r(z^{GF})) + z^{GO}] = 1 \tag{11}$$

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[21] It is assumed that when observing a signal that the asset is not stolen, the buyer is acting "naively" by relying on the signal. A more sophisticated approach would be to allow the buyer, after observing the signal that the asset is not stolen, to infer a positive posterior probability that the asset is stolen.

$$t_y(x^{GF},y^{GF})[1- \theta r(z^{GF})]v= 1 \quad (12)$$

There may be a corner solution, in which $y = 0$. This will occur if and only if:

$$t(x^{GF},y^{GF})[1- \theta r(z^{GF})]v - y^{GF} < 0. \quad (13)$$

Then, the thief is better-off refraining from theft. If a "theft-deterring" equilibrium arises, in it the owner will choose $\bar{x}^{GF}$, the least costly theft-deterring level of precaution, which is the lowest x that satisfies the constraint:

$$t(\bar{x}^{GF},y)[1- \theta r(z^{GF})]v - y \leq 0 \quad \forall y \quad (14)$$

In sum:

Under the Buyer in Good Faith regime, the thief spends y^{GF} in theft effort unless(13) holds, in which case he spends 0; the owner spends x^{GF} on precaution unless (13) holds, in which case she spends $\bar{x}^{GF}$. If theft occurs, the owner will spend a search level of z^{GF}.

REMARK. *What determines θ*? The value of θ depends on the frequency of theft and on the buyer's expenditures on inquiry into the asset's history (which are not modelled). For example, a buyer of a work of art may incur costs to inquire whether it was stolen in the past, by demanding past bills of sale, consulting with experts, or checking with the Art Loss Register (a list consisting of names of 60,000 stolen or lost works of art). Good faith may be defined to include only situations in which the buyer took reasonable care in inquiring ownership and still did not know the asset was stolen. Indeed, Posner & Landes (1996) distinguish between a buyer who is merely "innocent" -- one that observes a signal

that the asset is not stolen -- and a buyer of "good faith" who observes that signal after investing in sufficient inquiry.[22] Adding the possibility of an endogenous θ would extend the analysis in several ways. First, the cost of this inquiry -- a pure transaction cost -- would have to be added. Second, by determining the accuracy of the signal, the buyer also affects the thief's payoff from theft, the investments in x and y, and the likelihood that the owner will need to search for the asset. However, it should be noted that for many goods there are no effective means of verifying ownership, and only exogenous factors (low price, shady sale surrounding) can alert the buyer.

V. Favoring the Owner

Under this regime, if the owner traces the asset to the buyer's possession, the owner can reclaim possession and title no matter how many precautions the owner had taken and regardless of the buyer's knowledge concerning ownership at the time of the transaction. To analyze the effect of the rule, begin again from the last stage. At the search stage, if theft occurred, the owner picks a search effort z. Since she may repossess the asset anytime she traces it, the owner's objective function is:

$$Max_z \; r(z)v - z \tag{15}$$

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[22] Introducing endogenous θ into the model could be treated as follows: Let b denote the buyers investment in inquiry; let $\theta(b)$ denote the probability that a buyer who invests b will identify a stolen asset, when offered one ($0 < \theta(0)$, $\theta' > 0$, $\theta'' < 0$, and $\theta(b) < 1 \; \forall b$). The *Favoring the Buyer* regime is a case in which the buyer sets $b^{FB} = 0$, as she expects to acquire uncontested ownership anyway. The *Favoring the Owner* regime is a case in which the buyer solves $min_b \; [(1 - \theta(b)r(z^{FO}))v - b]$. The *Good Faith* regime is a case in which a standard of b^* is set for the buyer as a condition for defeating the owner's claim and, if the standard is not set too high, the buyer will satisfy it.

which is characterized by the first order condition

$$r'(z^{FO})v = 1 \tag{16}$$

Moving back one period to the transaction stage, with probability θ the buyer will observe a signal that the asset is stolen, in which case the maximal price she will be willing to pay is $(1 - r(z^{FO})v$ -- discounted by the probability of the owner tracing the asset. Otherwise, with probability $1-\theta$, the buyer will observe a signal that the asset is not stolen, in which case she will be willing to pay up to her entire surplus, v. The thief will therefore offer either $p = (1 - r(z^{FO})v$ or $p = v$, depending on the signal the thief knows the buyer to observe, and the buyer will accept the offer.

At the theft stage, before the thief knows the buyer's signal, the thief's expected return from a successful theft is $[1 - \theta r(z^{FO})]v$. Thus, the owner and the thief simultaneously solve:

$$Min_x\ x + t(x,y)[v(1 - r(z^{FO})) + z^{FO}] \tag{17}$$

$$Max_y\ t(x,y)[1- \theta r(z^{FO})]v - y \tag{18}$$

The interior, theft-accommodating solution (x^{FO},y^{FO}) satisfies the first order conditions:

$$-t_x(x^{FO},y^{FO})[v(1 - r(z^{FO})) + z^{FO}] = 1 \tag{19}$$

$$t_y(x^{FO},y^{FO})[1- \theta r(z^{FO})]v= 1 \tag{20}$$

There may be a theft-deterring corner solution, in which $y = 0$. This will occur if:

$$t(x^{FO},y^{FO})[1-\theta r(z^{FO})]v - y^{FO} < 0. \quad (21)$$

Then, the thief is better-off refraining from theft. In this case, the owner will choose $\bar{x}^{FO}$, the least costly theft-deterring precaution level, which is the lowest x that satisfies:

$$t(\bar{x}^{FO},y)[1-\theta r(z^{FO})]v - y \leq 0 \quad \forall\, y \quad (22)$$

In sum:

Under the Favoring the Owner regime, the thief spends y^{FO} in theft effort unless(21) holds, in which case he spends 0; the owner spends x^{FO} on protection unless (21) holds, in which case she spends $\bar{x}^{FO}$. If theft occurs, the owner invests a search effort of z^{FO}.

REMARKS: (i) *Incentives to Reveal that the Asset is Stolen*. If the buyer could inquire into whether or not the asset is stolen, the *FO* regime gives the buyer the strongest incentives to make such inquiries, as they are the only available measure to prevent the loss of the asset.

(ii) *Bargaining Power*. If bargaining power is more equally divided between the thief and the buyer, theft will yield a smaller payoff, which will affect the incentives of the owner and the thief at the theft stage, as well as the probability of a successful theft.

VI. OWNER'S NEGLIGENCE

Under the Owner's Negligence regime, the owner may repossess the asset when she traces it if and only if her investment in protection satisfied a due level of care, $\bar{x}$. This regime is, in a sense, a "conditional" Favoring the Owner regime. In practice, legal systems

are reluctant to consider inadequate protection to be negligence, and to deprive owners of their rights in stolen goods merely for being negligent. Even jurisdictions that apply negligence standards in other priority contests (e.g., when goods are lost or deposited), explicitly reject such standards in the context of theft.[23]

Under this regime, if the owner satisfies the level of due care, at the search stage she will invest z^{FO}, the same level that she spends under the *FO* regime. Alternatively, if she does not satisfy the level of due care, she will invest 0 (as under the *FB* regime). At the transaction stage, if the owner had taken $x \geq \bar{x}$, then the thief can sell the asset either for the price v or for the price $(1-r(z^{FO}))v$, depending on the buyer's signal. And if the owner had taken $x < \bar{x}$, then the thief can sell the asset for the price v, independent of the buyer's signal.

At the theft stage, the owner chooses x to minimize:

$$\begin{cases} x + t(x,y)[v(1 - r(z^{FO})) + z^{FO}] & \text{if } x \geq \bar{x} \\ x + t(x,y)v & \text{if } x < \bar{x} \end{cases} \qquad \textbf{(23)}$$

And the thief chooses y to maximize:

$$\begin{cases} t(x,y)v[1 - \theta r(z^{FO})] - y & \text{if } x \geq \bar{x} \\ t(x,y)v - y & \text{if } x < \bar{x} \end{cases} \qquad \textbf{(24)}$$

What is the level of due care $\bar{x}$ that society should set for the owner? Notice that if it is set too low, the owner may ignore it and choose a level that exceeds it. Specifically, if

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[23] This is the situation in England. See sources cited, supra note 5.

$\bar{x} < x^{FO}$ the owner will prefer to take x^{FO}, as she would do under the *FO* regime.[24] In addition, if $\bar{x}$ is set too high, again the owner may elect to ignore it, as she would rather lose the right to repossess the asset than spend too much in protecting it. At the optimum, $\bar{x}$ would be set at the incentive-compatible region, at a level that satisfies the social optimum first order condition:

$$t_x(\bar{x},y^*(\bar{x}))z^{FO} + \frac{\partial y^*(\bar{x})}{\partial x}[t_y(\bar{x},y^*(\bar{x}))z^{FO} + 1] + 1 = 0, \qquad \textbf{(25)}$$

where $y^*(x)$ is the choice of y derived from the upper function of expression (24). Expression (25) says that at the optimum, a perturbation of x should yield 0 net welfare effects. That is, an increase in x should lead to changes in y and the expected cost of z, such that sum up to zero.

By setting a standard of due care, society can, for one, induce a shift from the theft-accommodating equilibrium to the socially superior theft-deterring equilibrium. When, under the normal operation of the *FO* regime, theft is accommodated (expression (21) is not satisfied), the owner can be given the added incentive to increase her protection effort so as to qualify for the protection of the *FO* regime, and consequently deter theft. Specifically, $\bar{x}$ should be set at the threshold theft-deterring level $\bar{x}^{FO}$ if it will induce the owner to take this level -- that is, if:

$$\bar{x}^{FO} \leq x^{FB} + t(x^{FB},y^{FB})v, \qquad \textbf{(26)}$$

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[24] Unlike the operation of negligence regimes in tort law, in this case the owner cannot escape all "accident losses" simply by taking due care, since she may still bear the cost of untraced theft. Thus, the owner may want to take more than what is legally required.

that is, the owner must be better off taking $\bar{x}^{FO}$ and deterring theft than failing this standard and thereby collapsing to an equilibrium identical to the one arising under the *FB* regime.

In sum:

Under the Owner's Negligence regime, if the standard of care is set at $\bar{x} = \bar{x}^{FO}$, then the owner will satisfy it and the thief will spend $y = 0$ if and only if (26) holds; otherwise, the owner will spends x^{FB} and the thief y^{FB}. The owner cannot be led to take fewer precautions than she would take under the FO regime, but can be induced to take more precaution than under any other regime. If theft occurs, it is followed by a search effort of z^{FO} by the owner.

REMARKS. (i) *Inducing a Theft-Deterring Outcome*. This regime can induce the owner to take *more* precaution than would otherwise arise under the equilibrium of the *FO* regime. The added instrument of the standard of care can be used to raise social welfare by shifting the outcome from the interior solution that could otherwise arise under the *FO* regime to the corner solution. In other words, by threatening to deprive her of the ex post chance to retrieve the asset if she does not exercise this precaution, the owner can be given the added incentive utilize a protection measure. For example, by conditioning car owners' right to retrieve stolen cars from buyers on having installed Lojack systems, car owner can be given the added incentive to install this device.[25] This analysis suggests that the law's reluctance to condition owners' priority on adequate pre-theft care is not optimal. An

[25] See Ayres and Levitt [1997] for an estimate of Lojack's private versus social benefits.

effective policy instrument is wasted.

(ii) *Information*. In order to set a feasible and desirable standard, courts have to know more than assumed until now (that is, more than the signal that the buyer observed). Courts have to know the functions that determine the parties choices of x, y and z, and observe the actual level of x taken by the owner. The civil courts, under which title claims by owners are usually administered, are often deprived of investigative powers that are available to criminal courts, which can credibly expose these ad-hoc characteristics. Therefore, the applicability of this regime is limited, which may explain why legal systems disregard it as a policy instrument.

VII. Comparison of Regimes

Having examined behavior under the four regimes, we can proceed to compare the results. In this section, we will examine each behavioral variable separately, and attempt to compare the performance of the different regimes with respect to that variable.

A. Search

Proposition 1: *If the asset is stolen, the investment by the original owner in search is greatest under the Favoring the Owner and Owner's Negligence regimes, smaller under the Good Faith regime, and smallest under the Favoring the Buyer regime*.

Proof. We have established that $z^{FB} = 0$, $z^{FO} > 0$ and that $z^{GF} > 0$. From equations (8) and (16) we know that $r'(z^{FO}) < r'(z^{GF})$ for all $\theta < 1$, which implies $z^{FO} > z^{GF}$. ■

Remarks. (i) *Intuition.* That the owner spends the most on searching and retrieving her

asset under the *Favoring the Owner* regime (and the same amount under the *Owner's Negligence* regime) is obvious. When the owner knows she has the priority she will spend more that when she is uncertain (the GF regime) or knows she does not have the priority (the *FB* regime). Note that under the Owner's Negligence regime, if the standard of care is set at the theft-deterring region, then the owner will spend 0 on search, as theft will be fully deterred. An interesting question, which Proposition 1 does not answer, is under which regime the *expected* amount of search (i.e., the magnitude of the search effort multiplied by the probability of theft) is lowest.

(ii) *Search Costs as a Proxy for Enforcement Activity*. Ordinarily, the effort to locate stolen assets is invested by a public agency and not by the owner-victim. The incentives of agencies to exert effort may differ from the private incentives of victims (see, e.g., Ben-Shahar and Harel [1995].) However, inasmuch as victims take some role in the enforcement mechanism (e.g., hiring private investigators, testifying in court), one may expect their incentives to participate to be ranked as in Proposition 1. In addition, inasmuch as public enforcement is often fueled by victims' interest to retrieve their assets (e.g., filing complaints), then the search variable in this model can approximate the social effort of theft detection.

(iii) *Private versus Socially Optimal Levels of Search.* From a social perspective, the first-best level of search is 0, since, viewed ex post, search can only lead to transfer -- it is a rent-seeking activity. Viewed ex ante, however, search has a positive value: it may reduce the buyer's valuation of the asset and consequently may lead to a reduced theft effort and lower investments in protection. Thus, in situations in which privately funded

search is not taken (as under the *FB* regime), society can improve matters by publicly funding search. Specifically, legal systems that opt for a pro-buyer priority rule should complement this with a practice of intensified theft enforcement. Notice also that when search does occur, its level is generally inefficient. The private benefit to the owner from conducting search is different from the social value. The private benefit is the chance to retrieve the asset (which, from a social perspective, is a pure transfer), whereas the social benefit is the ex ante effect at the theft stage.

B. Transaction Price

PROPOSITION 2: *The expected transaction price is highest under the Favoring the Buyer regime, smaller under the Good Faith regime, and smallest under the Favoring the Owner regime (which is the same as under the Owner's Negligence regime).*

Proof. The price under the *FB* regime is guaranteed to be v, the maximal possible price. Under both the *GF* and *FO* regimes there is a probability θ that the price will be lower than v. Under the *FO* regime it will be $(1 - r(z^{FO}))v$ and under the *GF* regime it will be $(1 - r(z^{GF}))v$. From Proposition 1 we know that $z^{FO} > z^{GF}$, thus $(1 - r(z^{FO}))v < (1 - r(z^{GF}))v$. ■

REMARKS. (i) *Intuition.* Under the *FB* regime the price of the stolen asset is highest since there is no risk involved in the purchase. Under both the *GF* and *FO* regimes the buyer faces a risk in purchasing the asset when it is known to be stolen -- the risk of the owner finding and repossessing it. But this risk is smaller under the *GF* regime, since the buyer knows that the owner's incentives to search are smaller under the *GF* regime relative to

the *FO* regime. That is, under the *GF* regime a bad faith buyer enjoys the restraining effect that good faith buyers have on the search activity of the owner, and is thus willing to pay a higher price.

(ii) *Bargaining Power*. The prices calculated above are based on the assumption that the thief can extract the maximal price the buyer is willing to pay. Under different assumptions concerning the relative bargaining powers of the thief and the buyer, different prices can be expected to arise. But as long as the bargaining procedure is assume to be unaffected by the priority rule, the same ranking of the regimes with regard to the expected prices will arise.

(iii) *Allocative Inefficiency*. The ranking of the prices can have an effect (which is beyond the scope of this model) in determining the efficiency of the assets' allocation. If buyers can vary with respect to their valuation of the asset, then the lower the price, the more likely is the asset to wind up in the hands of a buyer with lower valuation than the original owner (and remain there, as the buyer may wish to conceal his suspect purchase). Thus, while a high price encourages theft and theft-related expenses, it also guarantees smaller allocative inefficiency.

C. Owner's Precaution

PROPOSITION 3: *The owner's investment in precaution will be greatest under the Favoring the Buyer regime, smaller under the Good Faith regime and smallest under the Favoring the Owner regime. The investment under the Owner's Negligence will be no smaller than under the Favoring the Owner regime, and may be higher than under all*

other regimes.

Proof. Comparing the first order condition of the owner's objective function (equations (3), (11) and (19)) shows that the owner's incentives to invest are greatest under the *FB* regime, less under the *GF* regime and least under the *FO* regime.[26] That is, other things (including the thief's effort y) held equal, the above ranking arises. When examining the actual choice of x in equilibrium, y cannot be held equal. But since $\hat{y}^{FO}(x) < \hat{y}^{GF}(x) < \hat{y}^{FB}(x)\ \forall\ x,$ the ranking stands. Under the Owner's Negligence regime, the owner will not take less than x^{FO}, even if the standard is lower. If the standard is higher than x^{FB}, he may take more than x^{FB}. He will do so if $\bar{x} - t(\bar{x},y^{*}(\bar{x}))[r(z^{FO})-z^{FO}] \leq x^{FB}$, which, for $\bar{x}$ sufficiently close to x^{FB}, must hold.■

REMARKS. (i) *Intuition*. The owner will invest the least in precaution under the *FO* regime since the threat of theft is the least intimidating. There are two reasons why the threat of theft is less intimidating. The obvious one -- the owner may retrieve her asset even if it is stolen and sold; and a more subtle one -- the thief's incentives to invest in theft are weaker, given the lower price the thief can extract. Under the *GF* regime, the owner will invest more in precaution both because he expects to retrieve the asset less often and because he expects the thief to invest more effort, given the higher price that the thief can extract. This effect will be reinforced under the *FB* regime, in which the owner's chances of retrieving the asset are the smallest (zero) and the thief's effort to steal are the greatest. Note that under the *ON* regime, the owner can be induced to take $\bar{x}^{FO} > x^{FO}$ to completely

[26] This arises directly from the fact that $v > v(1 - \theta r(z^{GF})) + z^{GF} > v(1 - r(z^{FO})) + z^{FO}$.

deter theft. However, this level may not suffice to deter theft under the *FB* and *GF* regimes.

(ii) *Social Desirability of Private Protection*. Whether or not it is desirable to encourage owners to take more protection measures depends on the social value of these measures. It may be that most of these measures merely divert theft, in which case there is little social value in encouraging high levels of precaution (see Shavell [1991]). However, protection which is induced by the property rights in stolen goods operate on all owners alike, and hence is not likely to create theft diversion, but likely to create the desirable effect of theft deterrence.

D. Theft Effort

PROPOSITION 4. *Comparison of theft efforts across regimes is ambiguous: any ranking of the regimes is possible.*

Intuition. All things held equal, the thief has the weakest incentive to invest in theft under the *FO*, stronger under the *GF* regime and strongest under the *FB* regime, because of the ranking of the sale prices under these regimes. But when taking into account that the owner's investment in protection varies across regimes, the result may change. Under the *FO* regime there is the smallest return to successful theft, but it is also relatively easiest to steal, since (by Proposition 3) precaution levels are lowest. Under the *GF* regime there is a larger return to a successful theft, but it is also harder to accomplish a successful theft, due to the higher precaution the owner takes. And under the *FB* regime the return to

successful theft is highest, but theft is also hardest to achieve. Under the *ON* regime the level of y depends on the standard of x. As x increases above x^{FO}, the level of y drops. Hence, the net effect on y across these four regimes is ambiguous. ■

REMARKS. (i) The comparison made in Propositions 3 and 4 can be depicted graphically (See Figure III). Comparing (x^{FO},y^{FO}), (x^{GF},y^{GF}) and (x^{FB},y^{FB}) shows that while the owner is spending less on precaution, the thief may invest less, more, or the same amount on theft.

Insert Figure III here

(ii) *The Likelihood of Theft*. Since we cannot determine the ranking of theft effort across regimes, we cannot determine unambiguously where the probability of theft is greater. Even though more precaution against theft is invested under the *GF* regime and even more under the *FB* regime, the probability of theft cannot be ascertained without reference to the equilibrium theft effort. This result contrasts previous claims made in the literature regarding the relative frequency of theft. It is usually contended that a regime which gives the buyer a safer status would lead to increased rates of theft.[27] What this literature overlooks is that the more powerful the buyer's right against the owner, the more protected the owner will be, and the harder for theft to succeed. This restraining effect may or may not dominate the effect of the buyer's higher willingness to pay for the asset.

E. Theft Deterrence: Comparison of Corner Solutions

[27] See, e.g., Weinberg [1980], at 574-575; Schwartz and Scott [1991] at 509-510.

A corner solution, in which the owner's precaution successfully deter the thief from attempting to commit theft, may arise under either regime. The following Proposition compares the likelihood of the corner solution under the different regimes.

PROPOSITION 5. *(a) It takes the least amount of precaution to deter theft under the FO regime, more under GF regime and the most under the FB regime:* $\bar{x}^{FO} < \bar{x}^{GF} < \bar{x}^{FB}$; *(b) Theft may be deterred under any one regime and not the others, or any combination of regimes.*

Proof. (a) Comparing equations (6), (14) and (22), which characterize the theft-deterring precaution level under the first three regimes, and setting $y = 0$ in these equations, we get $t(\bar{x}^{FB},0) < t(\bar{x}^{GF},0) < t(\bar{x}^{FO},0)$, which implies that $\bar{x}^{FO} < \bar{x}^{GF} < \bar{x}^{FB}$.

(b) First, a corner solution may arise only under the *FB* regime (the case in which equation (5) holds but not equations (13) and (21).) From Proposition 3, x^{FB} is greater than either x^{FO} or x^{GF}, and that effect alone may account for theft deterrence. Second, a corner solution may arise only under the *FO* regime (equation (21) holds but not equations (5) or (13).) Since the reward to the thief from a successful theft is lowest under this regime -- that is, $[1-\theta r(z^{FO})]v <$ $[1-\theta r(z^{GF})]v < v$ -- this effect alone may account for theft deterrence. Lastly, a corner solution may arise only under the *GF* regime. For this to arise, it must be that the greater precautionary effort relative to the *FO* regime accounts for equation (13) holding but not equation (21), and the lower reward to theft relative to the *FB* regime accounts for

equation (13) holding but not equation (5). Under the *ON* regime, the corner solution can arise through an appropriately high standard, even if it does not arise under the *FO* regime. ■

REMARKS. (i) *Theft Deterrence only under the FB Regime.* A corner solution can arise only under the *FB* regime due to the increased precaution incentive. Knowing she cannot retrieve a stolen asset, the owner may wish to do more to prevent theft, more than she would do when she expects some likelihood of repossessing the asset.

(ii) *Theft Deterrence Only under the FO Regime*. For a corner solution to arise only under the *FO* regime it must be that the effect of this regime's relative low rewards to theft dominates the effect of increased precaution. Both the *FB* and the *GF* regimes generate higher tendencies for theft relative to the *FO* regime, due to the higher expected price the thief can extract. In the corner solution the thief's reduced ability to resell the asset does more for deterrence than the owner's reduced precaution.

(iii) *Theft Deterrence Only under the GF Regime*. A corner solution may arise only under the *GF* regime. This is the mixed case in which, relative to the *FB* regime, the low reward to theft deters theft only in the *GF* regime and, simultaneously, relative to the *FO* regime, the low probability of success deters theft only in the *GF* regime.

(v) *Theft Deterrence under the Owner's Negligence Regime*. While theft may not be deterred the first three regimes, it may be deterred under the Owner's Negligence regime with a sufficiently high standard of due care.

VIII. CONCLUDING REMARKS

A. Theft Insurance

Risk-averse owners and buyers may purchase insurance which will affect their incentives to engage in the actions examined above. Owners purchase theft insurance; buyers may be insured by mediating retailers. In these situations, the incentives for owners may be provided by the insurance companies and the actions attributed by the model to buyers will be taken by the mediating traders. Hypothetically, if it is easier for owners to insure against theft than for buyers to insure against buying stolen goods (due to, say, information problems), one could expect a stronger dilution of incentives at the protection stage. This is another aspect in which an Owner's Negligence regime would be instrumental. It could complement the efforts of insurance companies to monitor owners' incentives.

B. Other Methods of Regulating Victim Precaution

Priority rules in property contests are one of several mechanisms through which society can influence the level of precaution taken by theft victims. Society can use centralized mechanisms to regulate private enforcement practices or to tax (or subsidize) protection devices. Alternatively, there are other decentralized mechanisms that effectively "punish" theft victims who do not protect themselves optimally. One such policy is to adjust the sanction to the thief according to his victim's precaution level (see Ben-Shahar and Harel [1995]). Another policy is to mandate insurance incentives so as to provide incentives for socially optimal precautions. Given the magnitude of resources invested in

self-protection in the economy, there is room for additional work that will examine ways of monitoring these investments.

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