The Importance of Being Honest*

MURRAY C. KEMP and YEW-KWANG NG

University of New South Wales, Kensington, NSW 2033
Monash University, Clayton, Victoria 3168

Given individual propensities to cheat (stealing, overcharging, etc.), the optimality conditions for the amount of resources devoted to law enforcement and for the severity of penalties on convicted cheats are derived. In some interesting cases, the optimal penalty equals the market price divided by the probability of conviction and it is optimal to spend very little on enforcement and impose a severe penalty. These conclusions seem to apply to the practical case of metered parking violation.

I Introduction

All forms of cheating (stealing, short-weighting, overcharging and quality dilution) have in common the implication that some individuals (the thieves, shortweighters, quality dilutors) pay lower prices (or receive higher prices) than do other individuals. This raises the following question: Given individual propensities to cheat, should those propensities be thwarted by law and law-enforcement and, if so, in precisely what manner and degree? This question contains two sub-questions: What volume of resources should be devoted to law enforcement? What penalties, if any, should be imposed on convicted cheats?

For the most part we shall be concerned with the second of these questions, simply taking expenditure on law enforcement as given. Nevertheless we shall not entirely neglect the first question. The conclusions of the paper are summarized in a formal proposition at the end of Section II. Section II contains our analysis, Section III a small ‘application’.

II Analysis

We consider an economy consisting of \( s \) consumers, possibly including the government. In the absence of cheating, we may consider the social problem of maximizing a welfare function

\[
W(U_1(X_1^1, \ldots, X_n^1), \ldots, U_s(X_1^s, \ldots, X_n^s))
\]

subject to the net production constraint

\[
F(X_1, \ldots, X_n) = 0
\]

where \( U_i \) is the utility of the \( i \)th individual \((i = 1, \ldots, s)\), \( X_j^i \) is the consumption by the \( i \)th individual of the \( j \)th commodity, \( X_j = \sum_{i=1}^{s} X_j^i \) is the total net output of the \( j \)th commodity (negative if the \( j \)th commodity is a net input), and where the constraint (2) is derived from a non-increasing-returns technology. Though we describe (2) as the production constraint, its form is general enough to include, say, the possibility of international trade so that (2) becomes the net consumption (not necessarily equal to domestic production due to trade) constraint. For optimality it is necessary that

\[
\frac{U_j^i}{U_j^s} \leq F_j/F_n \quad (= F_j/F_n \text{ if } X_j^i \neq 0)
\]

\[
j = 1, \ldots, n-1
\]

\[i = 1, \ldots, s\]

\[\]

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1 In Kemp and Ng (1976), we show that a welfare function such as (1) in the text does not exist if it is to be based only on individual orderings and satisfies the Pareto principle. However, one can have a welfare function based on, e.g., cardinal utilities.
where
\[ W_i U^i_n = W_j U^j_n \quad i,j = 1, \ldots, s \]  
(3b)
and it is assumed that all individuals consume the \( n \)th or numéraire good. As is well known, these conditions will be fulfilled in a competitive equilibrium if the distribution of resource-ownership happens to be just right or if corrective lump-sum transfers are feasible and carried out.

Let us now introduce the possibility of illegitimate usage of the first commodity (nothing essential is lost in confining attention to just one commodity). Two polar cases will be considered. In the first of these, illegitimate usage is divisible without additional cost into as many sub-acts as desired. Divisibility becomes relevant if individuals are averse to risk, for then the pooling of risks is both desired and feasible. We therefore couple the assumptions of divisibility and risk aversion, though divisibility as such does not rule out non-risk aversion. In the second polar case, illegitimate usage is taken to be indivisible. The analysis of this case focuses on the single act of illegitimate usage. Moreover, the possibility of risk preference must be considered.

**Divisibility**

We must now re-write the utility functions as
\[ U^i(X_{11}^i, X_{11}^i, X_2^i, \ldots, X_n^i) \quad i = 1, \ldots, s \]  
(4)
and the production constraint as
\[ F(X_{11}^i, X_{11}^i, X_2^i, \ldots, X_n^i) = 0 \]  
(5)
where \( X_{11}^i \) and \( X_{11}^i \) appear as separate arguments of \( U^i \) because an individual may be averse to, or favour, illegality. The terms \( X_{11}^i \) and \( X_{11}^i \) appear as separate arguments of \( F \) to allow for the possibility that the act of cheating itself entails social costs). Later we shall refer to the \( i \)th individual as scrupulous, non-scrupulous or unscrupulous according as \( U_{11}^i \) is greater than, equal to or less than \( U_{11}^i \) when \( X_{11}^i = X_{11}^i \).

For optimality it is necessary that (3a) and (3b) hold, with one change—for (3a), with \( j = 1 \), we must substitute
\[ U_{11}^i/U_n^i \leq F_{11}^i/F_n^i \quad (= \text{if } X_{11}^i \neq 0) \]  
(6)

Let \( x \) be the probability of being caught in any particular act of illegitimate usage; to the individual, \( x \) is given, independent of his decisions. Let \( f \) be the rate of fine or damages if caught and convicted; and let \( c \) be the constant unit cost of illegitimate usage (the effective price paid by the illegitimate user before penalties are included). For simplicity, \( x, f \) and \( c \) are taken to be the same for all individuals. The analysis can be extended without difficulty to cover the more general case. In that case the optimal structure of penalties would not be uniform over individuals. Since the individual is risk averse, he finely subdivides his illegitimate activity, pools his risks and pays exactly \( aX_{11}^i \) in penalties. For him the effective and certain price of the illegitimately-acquired commodity is \( (af + c) \). With uncertainty playing no role, he maximizes (4) subject to
\[ P_i X_{11}^i + (af + c)X_{11}^i + \sum_{j=2}^n P_j X_j^i = I^i \]  
(7)
where \( P_i \) is the market (or ‘legitimate’) price of the \( j \)th commodity and \( I^i \) is the income of the \( i \)th individual. The relevant individual optimality conditions are
\[ U_{11}^i/U_n^i \leq P_i \quad (= \text{if } X_{11}^i \neq 0) \]  
\( i = 1, \ldots, s \)  
(8)

Comparing (8) and (6), one deduces that an optimum is attained if the penalty paid by the illegitimate user is set at a level such that
\[ a = (P_1 - c) + (F_{11} - F_{11})/F_n \]  
(9)
where \( P_1 - c \) is the measure of the illegitimacy in usage and \( (F_{11} - F_{11})/F_n \) is the additional cost of production generated by a marginal shift from legitimate to illegitimate usage (conceivably, it may be negative). In the special case in which there are no additional costs of producing for illegitimate usage (so that \( X_{11}^i \) and \( X_{11}^i \) enter \( F \) as a sum and \( F_{11} = F_{11} \)) the optimal penalty is \( (P_1 - c)/a \) and the net price of the first commodity is the same whether legitimately or illegitimately acquired. If, in addition, \( c = 0 \) (the case of pure stealing) then the optimal penalty is simply \( P_1/a \), that is, the market price divided by the probability of being caught. Finally, there is the very special case in which \( X_{11}^i \) and \( X_{11}^i \) enter \( F \) as a sum and, in addition, \( X_{11}^i \) and \( X_{11}^i \) enter \( U^i \) as a sum (so that the \( i \)th individual is non-scrupulous).
Then, clearly, there is no loss of welfare if illegitimate usage is so heavily penalized that it disappears. In this case the optimal penalty is not unique; any value at or above the level indicated by (9) will serve, and any rate above that level will suppress illegitimate usage.

Given that \( f \) is optimally set, (8) and (7) yield the \( i \)th individual's choice of \( X_{iL} \) and \( X_{iI} \). Total consumption of the first commodity \( (X_{iL} + X_{iI}) \) may be greater or less than when illegitimate usage is suppressed. In the special case (already mentioned) in which each individual is non-scrupulous, looking only at the net (penalty inclusive) price of the first commodity and caring not at all whether it is acquired illegitimately or legitimately, the first commodity is the same with and without illegitimate usage. (For a detailed examination of optimal policy towards smuggling based on these very special assumptions, see Kemp, 1976.)

We note that, whatever value \( a \) has, provided only that it is positive, there always exists an optimal value of \( f \). Now \( a \) is presumably an increasing function of expenditure on law enforcement. (It may also depend on the volume of illegitimate activity.) We may conclude, then, that it is optimal to spend on law enforcement the minimum necessary to make \( a \) positive.\(^2\) In this limited sense, cheating hardly matters.

Finally, we note that nowhere in our analysis have we allowed for the possibility that illegitimate usage creates uncertainty for the cheated. The reason is that if cheating is properly penalized and if the penalties are paid to the cheated then, in the case of perfect divisibility, no uncertainty is created.

Indivisibility

Illegitimate usage is now viewed as a single indivisible act. During the relevant time interval, an individual engaging in such an activity may or may not be caught—the alternatives are now mutually exclusive. Hence the desideratum of the \( i \)th individual is taken to be his expected utility \( E\{U^i\} \). To rule out the possibility that an exuberant risk-prefering individual cannot pay the penalties imposed upon him, we introduce further penalties, on bankruptcy, so heavy that no individual ever chooses to risk that outcome. For convenience, without any bearing on our qualitative conclusions, it is assumed that all penalties are assessed and paid in terms of the numéraire. Thus each individual is constrained to choose in such a way that the maximum possible penalty is not greater than his chosen consumption of the numéraire. The objective of the \( i \)th individual is therefore to maximize:

\[
E\{U^i\} = (1 - \alpha)U^i(X_{iL}^i, X_{iI}^i, \ldots, X_n^i) + \alpha U^i(X_{iL}^i, X_{iI}^i, X_2^i, \ldots, X_n^i)
\]

(10)

where \( X_{nI}^i = f X_{iI} \) is his consumption of the numéraire after payment of the fine. The objective is taken to be the maximization of \(^3\) subject to

\[
F(X_{iL}, X_{iI}, X_2, \ldots, X_n) = 0 \quad (5)
\]

where

\[
X_{iL} = \sum_{i=1}^{n-1} X_{iL}^i, \quad X_{iI} = \sum_{i=1}^{n-1} X_{iI}^i
\]

and

\[
X_n = \frac{\sum_{i=1}^{n-1} X_{nI}^i - \alpha \sum_{i=1}^{n-1} X_{iI}^i}{(j = 2, \ldots, n-1)}
\]

The last equality is justified by the assumption that the community consists of a large number of small individuals.

At first sight this problem seems to have a structure very different from that of its counterpart under divisibility. However all decisions are taken ex ante, before it is known whether the act of illegitimate usage has passed undetected. It follows that the expected utility function (10) can be written as

\[
V^i(X_{iL}^i, X_{iI}^i, X_2^i, \ldots, X_n^i)
\]

which has the same general form as (4). (It must be noted that \( V^i \) is expected utility.) Thus the analysis goes through as with divisibility and risk aversion. In particular, the optimal

\(^2\) We pass over the possibility that there does not exist a minimum, only an infimum.

\(^3\) Alternatively, we might have chosen the criterion \( E\{W(U_1, \ldots, U_n)\} \). One could sensibly argue for either choice of criterion. Our own choice was made partly on grounds of tractability. We note that if welfare is a sum (unweighted, or with constant individual weights) of utilities then the two criteria are equivalent. Thus \( W(E\{U_1^i\}, \ldots, E\{U_n^i\}) = \sum_j \theta_j W(U_1^i, \ldots, U_n^i) \sum_j \) probability of state \( j \). See Ng (1975).
penalty is still given by formula (9).\footnote{An alternative proof is contained in section (i) of the Appendix.} Individuals may differ greatly in their attitudes to risk and in their attitudes to illegitimate usage, and their rates of illegitimate usage will differ accordingly. (See section (ii) of the Appendix.) Nevertheless the same formula applies to all. Notice also that, except in very singular cases, it is not optimal to crush illegitimate usage. Even when \( X_{1L} \) and \( X_{1T} \) enter \( F \) as a sum and \( X_{1L}^i \) and \( X_{1T}^i \) enter \( U^i \) as a sum, in general it is sub-optimal to eliminate illegitimate usage. To set the penalty above the level indicated by (9) would induce some non-scrupulous individual with a sufficiently mild preference for risk bearing to shift from illegitimate to legitimate usage, and this would be sub-optimal. The suppression of illegitimate usage would be optimal if \( X_{1L} \) and \( X_{1T} \) enter \( F \) as a sum, if \( X_{1L}^i \) and \( X_{1T}^i \) enter \( U^i \) as a sum, and if, in addition, the population contains no risk-preferers; but then to set the penalty at the level indicated by (9) also would be optimal.

When illegitimate usage is indivisible it is not always optimal to reduce expenditure on law enforcement to the minimum necessary to generate a positive probability of conviction. If the community is risk-averse and if the marginal cost of reducing \( \alpha \) is small then it may be optimal to raise \( \alpha \) well above zero, perhaps to a level just short of one.\footnote{To pin down the optimal expenditure on law enforcement we insert \( \alpha \) as an argument of \( F \) in the constraint (5) and derive the additional first-order condition} the constraint (5) and derive the additional first-order condition. For example, it fails to accommodate the possibility that degrees of scrupulousness are endogenous variables or the possibility that some individuals may be rendered unhappy by the existence of cheating as such. Such considerations suggest a level of expenditure on law enforcement higher than that indicated by (18). However, there seem to be cases in which such considerations are unimportant and in which the extreme assumptions of our analysis are satisfied to a sufficient approximation. Consider the problem of choosing a level of fine and a degree of law enforcement in relation to metered parking space. Here illegal usage consists in parking caught, and if the compensation were equal to the penalties imposed, then in any interval of time the cheated might receive either more or less than adequate compensation; the risks of the cheated would not be completely pooled. However, over any interval of time, the aggregate penalties assessed are just adequate to effect complete compensation. Thus the government could guarantee compensation which is both prompt and adequate. If it is supposed that the government issues such a guarantee then our neglect of the risk of being cheated is justified.

\section*{Conclusion}

There emerges the following general proposition, valid for all cases, involving divisibility, or indivisibility, risk aversion or risk preference, scrupulousness or unscrupulousness.

\begin{proposition}
There exists a distribution of resources and a set of penalties for illegitimate usage which ensure that a social optimum can exist as a competitive equilibrium. The set of optimal penalties is given by (9). In an interesting special case (in which \( X_{1L} \) and \( X_{1T} \) enter \( F \) as a sum, and \( c = 0 \)) it is optimal to impose a penalty equal to the market price divided by the probability of being caught.
\end{proposition}

To the formal proposition we add that, when illegitimate usage is divisible, the optimal expenditure on law enforcement is the minimum necessary to generate a positive probability of being caught.

\section*{III Application}

Our analysis has been by no means comprehensive. For example, it fails to accommodate the possibility that degrees of scrupulousness are endogenous variables or the possibility that some individuals may be rendered unhappy by the existence of cheating as such. Such considerations suggest a level of expenditure on law enforcement higher than that indicated by (18). However, there seem to be cases in which such considerations are unimportant and in which the extreme assumptions of our analysis are satisfied to a sufficient approximation. Consider the problem of choosing a level of fine and a degree of law enforcement in relation to metered parking space. Here illegal usage consists in parking....
without paying or parking in excess of the time for which payment is made. Legal parking and illegal parking absorb similar resources—mainly, parking space. Moreover, it is unlikely that people care whether drivers pay parking fees or parking fines. Our analysis then suggests that the fine should be set at a level equal to the parking fee divided by the probability of being caught. Risk-aversers may choose to pay the fee, while risk-preferers may choose not to pay. Moreover, even a risk-averse or risk-neutral individual may find himself unexpectedly short of coins at the time of parking. To impose a fine higher than that indicated by our analysis would encourage such an individual to respond in a socially inefficient way, by searching too strenuously for small change or by submitting to the tyranny of the meter and curtailing some parking-dependent activity. Each response involves the substitution of socially less desirable activities for socially more desirable activities.

Now, for most people who own a car, parking is usually a repetitive activity. Moreover, parking inspectors are costly. Appealing to our analysis of divisible illegitimate usage, we conclude that the penalty should be high and expenditure on law enforcement low. Even if for some people parking is an infrequent occurrence (a single act), the fee is a small part of their total expenditures and hence the risks involved are small. This again suggests a low $a$ and a high $f$.

**IV Qualifications**

In conclusion we draw attention to some questionable assumptions which have been implicit in our discussion and consider some of the implications of relaxing them.

First, it has been assumed, implicitly, that nothing can be done by individuals to guard against fraud. Let us now recognize the existence of burglar alarms, auditors and shopwalkers. Evidently the payment of full compensation to any defrauded individual would destroy the incentive to install such safeguards. If in fact it were socially desirable that the safeguards be privately undertaken then the payment of full compensation would result in a suboptimal allocation of resources. If in fact it were socially desirable that the safeguards be privately undertaken then the payment of full compensation would result in a suboptimal allocation of resources. However, the essentials of our analysis can be preserved by simply relating the amount of compensation to the degree to which the private installation of safeguards approximates the socially desirable level.

Second, our distinction between the cases of divisibility and indivisibility is a rather artificial one, forced upon us by the fact that our analysis is restricted to a single time interval. If, instead, individuals were supposed to maximize over many such intervals then, even in the case of indivisibility, they could pool their risks, that is, the indivisibility would be less significant. In particular, the sharp asymmetry of our conclusions about the optimal expenditure on law enforcement would be blunted. In the not-very-interesting limit, as the horizon of both society and its individual members recedes indefinitely, indivisibility would lose all significance. Then, the conclusion that expenditure on law enforcement should be as small as is consistent with a positive $a$ would be valid quite generally.

Third, we have assumed that the probability of conviction is independent of the 'size' of the illegal act. While this may be true for some cases, it is certainly more general to take the probability as dependent on the size of the act. Thus, the probability of conviction is higher when smuggling 100 kilogrammes of heroin than when smuggling one gramme. This suggests that the penalty on small illegal acts should be proportionally higher than for big acts. For example, if the penalty on smuggling 100 kilogrammes of heroin is $Sx$, the penalty on smuggling one kilogramme should be larger than $Sx/100$. This seems to be consistent with the actual amounts of penalty imposed in practice.

**APPENDIX**

(i) For a maximum of (11) subject to (5) it is necessary that, for $i = 1, \ldots, s$,

$$W_i \cdot [(1 - \alpha) U_i^i + \alpha U_i^{i\prime \prime}] \leq \theta F_i \quad (= \text{if } X_{i \prime \prime} \neq 0)$$

(A1a)

$$W_i \cdot [(1 - \alpha) U_i^j + \alpha U_i^{j\prime \prime} - \alpha f U_i^{j\prime \prime}] \leq \theta F_i \quad (= \text{if } X_{i \prime \prime} \neq 0)$$

(A1b)

$$W_i \cdot [(1 - \alpha) U_i^j + \alpha U_i^{j\prime \prime}] \leq \theta F_i \quad (= \text{if } X_i^j \neq 0)$$

(A1c)

where a superscript $c$ indicates the value appropriate to the outcome that the illegitimate user is caught. Eliminating $\theta$ from (A1a)–(A1c), we obtain

$$W_i \cdot [(1 - \alpha) U_i^j + \alpha U_i^{j\prime \prime}] \leq \frac{F_i}{\alpha} \quad (= \text{if } X_i^j \neq 0)$$

(A2a)
\[
\frac{(1-\alpha)U_{i,t} + \alpha U_{i,t-1} - \alpha f U_{n,t}}{U_{i,t} + \alpha U_{n,t}} \leq \frac{F_{i,t}}{F_n} \quad (= \text{if } X_{i,t} \neq 0) \quad (A2b)
\]

\[
\frac{(1-\alpha)U_{i,t} + \alpha U_{j,t} - \alpha f U_{n,t}}{U_{i,t} + \alpha U_{n,t}} \leq \frac{F_j}{F_n} \quad (= \text{if } X_{i,t} \neq 0) \quad i = 1, \ldots, s \quad (A2a)
\]

\[
\frac{(1-\alpha)U_{i,t} + \alpha U_{n,t}}{U_{i,t} + \alpha U_{n,t}} \leq \frac{F_j}{F_n} \quad (i = 1, \ldots, s) \quad (A2c)
\]

\[
W_i, E(U_{i,t}) = W_j E(U_{n,t}) \quad i, j = 1, \ldots, s \quad (A2d)
\]

The \(i\)th individual maximizes (10) subject to
\[
P_1 X_{1,t} + P_2 X_{2,t} + \ldots + P_n X_{n,t} = L \quad (A3)
\]

For a maximum it is necessary that, for \(i = 1, \ldots, s, \)

\[
\frac{(1-\alpha)U_{1,t} + \alpha U_{1,t-1} - \alpha f U_{n,t}}{F_1} \quad (= \text{if } X_{1,t} \neq 0) \quad (A3a)
\]

\[
\frac{(1-\alpha)U_{i,t} + \alpha U_{i,t-1} - \alpha f U_{n,t}}{F_i} \quad (= \text{if } X_{i,t} \neq 0) \quad (A3b)
\]

\[
\frac{(1-\alpha)U_{i,t} + \alpha U_{n,t}}{F_i} \quad (= \text{if } X_{i,t} \neq 0) \quad (A3c)
\]

From (A2a), (A2b), (A3a) and (A3b) we again obtain (9).

(ii) To see how an individual's attitudes to risk and to illegitimate usage affect his rate of illegitimate usage, we substitute for \(c_1\) from (A1c) into (A1b) then divide by (A1c) to obtain
\[
\frac{(1-\alpha)U_{i,t} + \alpha U_{i,t-1} + \alpha f(1-\alpha)(U_{n,t} - U_{n,t-1})}{U_{i,t} + \alpha U_{n,t}} \leq \frac{F_i}{F_n} \quad (A4)
\]

If \(X_{1,t} = X_{1,t} = 0\) enter \(F\) as a sum then (A2a) and (A4) reduce to
\[
\frac{(1-\alpha)U_{i,t} + \alpha U_{i,t-1} + \alpha f(1-\alpha)(U_{n,t} - U_{n,t-1})}{U_{i,t} + \alpha U_{n,t}} \leq \frac{F_i}{F_n} \quad (A5a)
\]

and
\[
\frac{(1-\alpha)U_{i,t} + \alpha U_{i,t-1} + \alpha f(1-\alpha)(U_{n,t} - U_{n,t-1})}{U_{i,t} + \alpha U_{n,t}} \leq \frac{F_i}{F_n} \quad (A5b)
\]

respectively. The key magnitudes are \(U_{1,t} - U_{1,t-1}\) and \(U_{n,t} - U_{n,t-1}\). The term \(U_{1,t} - U_{1,t-1}\) reflects the individual's attitude to illegitimate usage, as already discussed; and the term \(U_{n,t} - U_{n,t-1}\) reflects his attitude to risk, being positive, zero or negative as the individual displays risk-preference, risk-neutrality or risk-aversion. It is now easy to see that, if the penalty is optimally set, a risk-neutral individual will engage in less or more illegitimate than legitimate usage of the first commodity according as he is scrupulous or unscrupulous; and a non-scrupulous individual specializes in legitimate or illegitimate activity according as he is a risk-aventer or a risk preferer. And so on.

REFERENCES

