Chapter 13: Law and Economics

I. Introduction: Law as a Strategy for Reducing Risk and Uncertainty

The core neoclassical model implicitly assumes that voluntary exchange is the only method of shifting resources from one person to another. For example, in an Edgeworth box, in the absence of exchange—whether accompanied by market wide prices or not—the goods stay in the hands of their original owners. Neither person ever even considers stealing from the other. Similarly, sellers and purchasers are assumed to always operate in "good faith." Commitments made to deliver goods after an initial payment or to provide payment after goods or services are delivered are, implicitly, always kept. There is no risk or uncertainty associated with intertemporal transactions in the core models.

Whether this is because the societies in which neoclassical economics emerged were relatively low-crime or relatively trustworthy societies, or the possibility of crime was simply ignored in order to clear the way to focus on essential elements of price determination, it remains true that such possibilities were left out of the models. That they were left out does not imply that they are irrelevant for price theory or for understanding the extent of economic development—it simply indicates that there are other aspects of market transactions that could potentially be brought into economic analysis in a manner that might shed light on both variations in the extent and efficiency of markets. Such analysis may also shed light on the effects of differences among civil and criminal law systems and on the scope of the networks of exchange, production, and innovation that constitute contemporary "markets." The effects of different legal systems on the extent of markets were neglected by much of the law and economics literature but are the main focus of this chapter.

In 1968, analysis of the effects of punishment on crime rates was begun by Gary Becker, who showed how rational choice models could be used to understand the decisions of criminals (modelled as rational law breakers rather than psychopaths or necessarily immoral or amoral persons) and also to characterize the interests that non-criminals have in discouraging crime. That work was followed in short order by books by Gordon Tullock (1971) and Richard Posner (1972), who began exploring the economic implications of judicial institutions, civil law systems, and the effects of changes in civil law on crime rates and economic development.

In the late 1990s, the application of results based on analysis of laws and legal institutions in the United States and Europe began to be incorporated into models of economic development and indices of the rule of law included in empirical study of differences among economic development and growth rates among countries round the world and through time, as noted and surveyed in Dam (2007). Differences in legal systems evidently have systematic effects on the extent of economic development.

This chapter develops relatively a series of lean models of the effects of laws and law enforcement on economically relevant crimes, contract predictability, accidental damages, that have implications about the extent of market networks that are consistent with the empirical evidences that legal systems have economic consequences.[1]

II. An Extreme Case, Hobbesian Anarchy

> Whatsoever therefore is consequent to a time of War, where every man is Enemy to every man; the same is consequent to the time, wherein men live without other security, than what their own strength, and their own invention shall furnish them withal. In such condition, there is no place for Industry; because the fruit thereof is uncertain; and consequently no Culture of the Earth; no Navigation, nor use of the commodities that may be imported by Sea; no commodious Building; no Instruments of moving, and removing such things as require much force; no Knowledge of the face of the Earth; no account of Time; no Arts; no Letters; no Society; and which is worst of all, continual Fear, and danger of violent death; And the life of man, solitary, poor, nasty, brutish, and short. [Hobbes, Thomas. (1651). *Leviathan* (pp. 70-71). Neeland Media LLC. Kindle Edition.]

The chapter on law and economics begins with a short analysis of a world without law and the limited opportunities for economic development associated with that setting if all individuals are pragmatists—simple utility maximizers where more is always better. This section uses elementary non-cooperative game theory to illustrate why life in a lawless society tends to be highly uncertain and unpleasant, even if it is not necessarily quite as unpleasant as Hobbes suggests. The rational choice models used for this purpose are those of individuals, but much the same logic would apply to settings in which approximately equal powerful groups such as extended families or tribes interacted in similar settings.

[1] For a similar and somewhat complementary overview of such models and results see Cooter and Parisi (2009).

The first choice setting analyzed is a setting analogous to the Edgeworth box. Two people live near to each other. Each has two possible types of strategies. They can use their time to produce useful resources for themselves by harvesting them from nature, or to try to take (steal) some their neighbor's production for the day or week. The following game matrix illustrates various combinations of payoffs associated with the possible time-allocation choices of the two neighbors. In game matrices, the strategies available to the participants are discrete rather than a continuum. This is sometimes a perfectly accurate representation of choice settings similar to the one modelled, but more often is a simplification to sharpen results and make the logic of the interdependence between decision makers clearer.

The payoff combinations of the matrix below assume that nature's bounty may be harvested with constant returns to the time invested, and that stealing produces control over a greater share of their neighbor's productive output as more time is invested in stealing—although their own output falls as time is shifted from productive uses to thievery (or self-defense). As more and more time is shifted to theft, reductions in their own production reduces the overall net gains from theft at the margin.

Table 13.1 The Hobbesian Dilemma as a Time Allocation Game
Payoffs as (Al, Bob)

Bob / **Al**	100% produce, 0% theft	75% produce, 25% theft	50% produce, 50% theft	25% produce, 75% theft
100% produce, 0% theft	100, 100	50, 125	15, 135	5, 120
75% produce, 25% theft	125, 50	75, 75	35, 90	25, 75
50% produce, 50% theft	135, 15	90, 35	50, 50	30, 45
25% produce, 75% theft	120, 5	75, 25	45, 30	25, 25

Non-cooperative games assumes that decisions are made independently of one another and that the participants each attempt to maximize their payoff from the game. Each cell includes payoffs for Al and Bob with Al's in the first location and Bob's in the second (Al's payoff, Bob's payoff).

The simplest way to think about their respective choices is to imagine that each participant maps out a "best reply function" similar to that previously used in the Cournot duopoly and multi-opoly market settings in Part I. However, in this case the best reply function is not generated analytically, but by inspection. Al says to his or herself, what should I do if Bob if invests all of his time in productive activities? If Bob invests 75% of his time in productive activities? If Bob invests half of his time in productive activities? If Bob invests 75% of his time in productive activities. If you underline each best response, you have characterized the players best reply function.

Nash equilibria occur in cells where both payoffs in a cell are underlined. It is only with such combinations of strategies where each is simultaneously on their best-reply functions.

In this particular matrix, there is only a single Nash equilibrium. If you look at Al's payoffs, you'll see that in this particular choice setting, Al should always invest 50% of his or her time in stealing from (or attacking) Bob. Al has a "**pure dominant strategy**." A single strategy is best (yields the highest payoff regardless of what Bob does. The game is symmetric—in that the strategies are all the same and the payoffs are mirror images of each other, so if Bob goes through the same thought process, he also has a relatively simple best-reply function, because he also has a dominant pure strategy. Bob will also invest 50% of his time in stealing from (or attacking) Al, regardless of what Al does.

The only place where the two best reply functions are both simultaneously satisfied is the cell where the payoffs are (50, 50). (Notice that this is the only cell in which both "payoffs" are underlined.) This is a Nash equilibrium, because—given what the other has chosen to do—neither can do better by changing their strategy. The high-lighted cell is the unique Nash equilibrium in this contest.

This outcome is not as bad as the one characterized by Hobbes (which could emerge under somewhat different assumptions about the tradeoffs between production and theft), but the equilibrium is still pretty bad. Only half of the feasible total output is produced and realized by each player. In economic terms, the real GNP of this community is only half its potential Real GNP, because of the prevalence of thievery.

That reduction in joint output will reduce the quality and extent of meals and of other necessities and material comforts for both community members—and their risk from crises of various kinds—because fewer reserves, if any, are accumulated. Opportunities for exchange, as in an Edgeworth box, are also more limited than they could have been. Keep in mind that this is not because of a failure to optimize. Both are doing the best that they can, given what the other is doing.

Notice that if a legal system existed that sufficiently penalized theft, more of that potential output might be realized. For example, if the expected penalties reduced payoffs from stealing by 40 in each of the cells where stealing occurs, a new pure dominant strategy emerges, namely fully use one's time productively. Such a fine lowers the payoffs sufficiently that stealing no long pays. It is in this manner that a legal system can be economically relevant.

A Continuous Form of the Hobbesian Dilemma

Game matrices allow for various non-standard "shapes" for the payoff functions since they are no longer continuous differentiable functions. In principle, the numbers can have any plausible pattern. If we model such a choice setting with continuous strategy domains, some of that flexibility is lost, but one gets a more realistic characterization of strategies and strategy sets, which are rarely of the all or nothing variety or simply lists of discrete strategies. The above choice setting can be modelled using abstract or concrete functional forms.

To create a choice setting where players can allocate their time any way that makes sense to them, one simply needs to characterize a production function and a stealing function for each player. If we have no reason to assume that the people are different, then we can assume that each has the same production and stealing functions. We, assume relatively simple concrete functions to provide numerical counterparts to the game matrix above.

Suppose that production takes place with constant returns to scale and is simply $Q^P_i=10T$. Suppose also that the stealing function ultimately determines how the goods produced are allocated. An example of such a function is $Q^S_i = [S_i/(S_i+S_j)]*[10T_i + 10T_j]$. The total resources controlled by participant i is Q^S, which is the amount of participant i's own production that is protected plus that taken from the other candidate. The term in brackets is the sum of the outputs of the two neighbors. Suppose that each participant has 16 hours to allocate between production and stealing, and that the time spent producing goods and services is denoted as T_i for player i. In that case, $T_i = 16-S_i$. We can use the substitution method to write player i's payoff function as:

$$Q_i = [S_i/(S_i+S_j)]*[10(16-S_i) + 10(16-S_j)] \quad (13.1)$$

Differentiating and solving and setting the result equal to zero will characterize i's best level of theft as a function of the time allocation decision of the other player.

$$dQ_i/dS_i = [S_j/(S_i+S_j)^2]\ [10(16\text{-}S_i) + 10(16\text{-}S_j)] - 10[S_i/(S_i+S_j)] = 0 \qquad (13.2)$$

To characterize i's best reply function, we want to solve for Si as a function of Sj. This turns out not to be possible, although some useful simplification of the first order condition is possible. First, multiply by $((S_i+S_j)^2$, then divide by 10 and then isolate the marginal cost term (the last term)

$$S_j\ [(16\text{-}S_i) + (16\text{-}S_j)] = S_i(S_i+S_j) \quad \rightarrow\ 32S_j\ \text{-}S_iS_j - S_j^2 = S_i^2 + S_jS_i \quad \rightarrow$$

$$32S_j - S_j^2 = S_i^2 + 2S_jS_i \qquad (13.3)$$

Equation 13.3 characterizes player i's best reply function, although no closed form solution for S_i* as a function of S_2 exists.

Nonetheless, and perhaps surprisingly, we can characterize the Nash equilibrium. In a symmetric game, a likely equilibrium is one where $S_i^* = S_j^*$. To determine whether such an equilibrium exists, assume that Si = Sj , substitute for S_j in the function characterizing participant i's best reply, then solve for S_i.

Substituting yields: $32S_i - S_i^2 = S_i^2 + 2S_i^2$

Dividing both sides by Si and gathering terms yields: $32 - S_i = 3S_i \rightarrow 4S_i = 32$. At the Nash equilibrium,

$$Si^{**} = Sj^{**} = 32/4 = 8 \text{ hours} \qquad (13.4)$$

At the Nash equilibrium each neighbor spends exactly half of his or her time attempting to steal (or equivalently attempting to protect his or he own production from predation) and so their collective output is only half what it could be, as was the case in the discrete case.

This was not entirely a coincidence, because a similar process was used to characterize the extent of resources under each player's control to generate the payoffs in the game matrix, although it was not exactly the same process.

What matters is not the specific numerical result but that the neighborhood is poorer because as long as significant time and attention is devoting to stealing rather engaging in productive activities. It is quite possible that voluntary exchange may take place among the two persons at the equilibrium that emerged, although not necessarily the case.

In either case, the Nash illustrates one of the potential impacts of activities that are often termed criminal activities on the extent of markets. Again, it is possible that a well enforced law against thievery can eliminate the problem. To characterize the optimal fine or fine schedule, take another look at equation 13.2, the first order condition. The first term is the expected marginal benefit or marginal revenue of theft. The second is the marginal cost of theft. To discourage all theft, the fine schedule simply has to make the marginal cost of theft larger than its marginal benefits for all possible combinations of stealing efforts by the two neighbors.[2] That property will induce a "corner solution" as in our very early analysis of why consumers often purchase zero units of goods that are for sale at a posted price.

Crime is another factor that is missing from the core neoclassical model, but which have economically relevant effects, and also one that can be incorporated into the model using the same rational choice models that ground neoclassical economics. Unlike entrepreneurship in chapter 8, however, the effect of crime is to retard economic development rather than spur it onwards.

III. Crime and Punishment in a More Civilized Society

The previous section illustrates an essential problem that confronts markets in the period before rules emerge that reduce a variety of activities that tend to reduce the extent of trade and the density of trading networks. There are many others that do not involve the creation of stable tradable rights that are in some sense protected, including fraud, but this section continues the focus on activities that tend to reduce the certainty over property and the health of those exercising control over them. Hobbes imagines that those trapped in his dilemma agree to form a government of some kind that enforces basic civil and criminal laws. Whether such agreements were ever consummated or not, the previous section shows why they might broadly increase the welfare of those living in a community. If the returns from stealing fall, less time would be invested in such activities and more time would be spent in productive activities that tend to increase supplies of necessities, material comforts, and reserves for crises.

This section assumes, as did Becker's original paper on crime and punishment, that law enforcement is more or less honestly undertaken and that fines or other punishments that can be

[2] This is not to imply that perfect enforcement of ownership rights is possible or easy, but simply to demonstrate that if it were, then rational choice models of crime imply that zero rates of criminal activity are, in principle, feasible. In larger communities, it is not always obvious who the criminals are.

given money-equivalents are imposed on those caught engaging in illegal (e.g., criminal) activities. It also follows Becker's and Tullock's analysis in assuming that not all crimes are reported, nor all criminals identified, brough to trial, convicted, and punished. This uncertain or probabilistic chain of events is represented as a probability of punishment function. The probability of punishment increases with the number of crimes undertaken and with the governmental resources devoted to the criminal just system, F = f(N, G), with f monotonically increasing in N and decreasing in G.

The punishment is denoted in dollars and may consist of a variety of penalties with J being the amount that a potential criminal would be willing to pay to avoid the punishment. J increases with the number of known crimes that an individual criminal has convicted of and with his or her opportunity cost employment, and the type of punishment imposed—that latter being held constant for the model, $J = j(N, w^0)$, with j increasing in N and decreasing in w^0. Other possible losses from engaging in crime such reduced self-esteem and diminished reputations among one's friends, family, and employers. These too are assumed to be constant for individual criminals in order to develop a relatively lean model of criminal decisionmaking.

The revenue generated by criminal activity varies with the type of crime engaged in and with the supportive criminal network known to the individuals contemplating criminal activities, as with stolen goods resellers (sometimes called fences). Thus individual criminals are assumed to have individualized revenue functions. The probability of punishment and it's magnitude is also affected by the existence of criminal networks which may provide routine methods for hiding after a crime has been committed and access to defense lawyers. Thus, the probability of punishment functions are also individualized. To simplify, we'll simply assume that each potential criminal's total revenue from crime increases with the number of crimes undertaken, $R_i = r(N_i)$, with the revenue function r_i being monotone increasing in N and subject to diminishing returns.

The expected net revenue from an individual's activity, Π_i, can be written as:

$$\Pi_i = r_i(N_i) - f_i(N_i, G) j_i(N_i, w_i^0) \tag{13.5}$$

Potential criminals are assumed to differ in their access to criminal networks, skill set, and assessments of the penalty schedules. The "i" subscript are intended to account for these factors, without explicitly modelling them. Criminal i's optimal crime rate, N*, can be characterized by differentiating equation 13.5 with respect to N and setting the result equal to zero.

$$\Pi_{iN} = r_{iN} - f_{iN} j_i - f_i j_{iN} = 0 \equiv H \quad at\ N_i^* \tag{13.6}$$

The first term is i's marginal revenue, and the latter is i's expected marginal cost. The functions are each individualized, as denoted by subscript i. Partial derivatives are also denoted with subscripts.

It bears noting that the presumed equality that characterizes N_i* may not occur in the positive domain (N>0) for all individuals. We can consider all those persons whose expected marginal costs are always greater than their expected marginal benefits to be "honest" in the sense that they never engage in crime given their productivity as criminals and their associated penalty schedules. Those who engage in crime rates greater than zero are a subpopulation of the community that are regarded to be criminals—although there may be a spectrum of such criminals from petty or occasional criminals (low N_i*) to full-time criminals (relatively high N_i*). The boundary between those two subgroups is not "given" but is determined by personal assessments of expected net revenues. If expected net revenues fall, the number of criminals falls. If those assessments increase, the number of criminals increases.

According to the rational criminal model, individual behavior changes as the marginal revenues and expected marginal cost of crime increases. To see the logic behind such claims, we'll use the implicit function theorem and equation 13.6 to characterize the crime rate of a typical criminal (one in the middle of the subset of individuals committing crimes).

$$N_i^* = n_i(w_i^0, G) \qquad (13.7)$$

The implicit function differentiation rule can be used to determine the effect of an increase in governmental resources to an honest and diligent judicial system on a rational criminal's behavior:

$$N_{iG}^* = \mathrm{dH/dG/\text{-}(dH/dN)} = [-f_{iNG}j_i - f_{iG}j_{iN}]/-[r_{iNN} - f_{iNN}j_i - 2f_{iN}j_{iN} - f_ij_{iNN}] < 0 \quad (13.8)$$

The denominator is again positive if we assume that the expected net revenue function for criminal i is strictly concave. The numerator determines the qualitative response of a rational criminal to increases in the probability of punishment. We'll focus on those terms. The probability of punishment increases with N and G and so the cross partial in the first term is positive. The terms j_i and j_{iN} are both positive, so all the terms with partial derivatives in them are also positive. Their respective multiplication by negative signs implies that the numerator has a value that is less than zero.

Criminals diminish their crime rates as enforcement efforts increase, because an increase in expected punishments increases each criminal's marginal cost. Although not modelled, that effect also diminishes to some extent the population of criminals by reducing the expected net income associated with crime for "marginal" criminals. Both effects imply that crime rates fall in the community of interest.

The implicit function differentiation rule can also be used to determine the effect of an increase in the typical criminal's opportunity cost (here proxied by their wage rate in the non-criminal sector:

$$N^*_{iw^0_i} = \mathrm{dH/dw}^0_i / -(\mathrm{dH/dN}) = \frac{[-f_{iN} j_{\mathrm{iw}^0_i} - f_i j_{iN\mathrm{w}^0_i}]}{-[\Pi_{iNN}]} < 0 \qquad (13.9)$$

The denominator is again positive if we assume that the expected net revenue is strictly concave. (The denominator is the same as for equation 13.8, but is written in a shorter form.) The severity of the perceived punishment increases with the opportunity cost wage and so the cross partial is also positive. f_i and f_{iN} are both positive, so both the terms with partial derivatives in them are positive. Their respective multiplication by negative signs implies that the numerator is less than zero.

Overall, the model implies that rational criminals diminish their crime rates as the perceived marginal punishment increases and as the opportunity cost of criminal activities increase, because both variables increase each criminal's expected marginal cost—other things being equal. Although not modelled, that effect also diminishes to some extent the population of criminals by reducing the expected net income associated with crime for "marginal" criminals.

Together these effects suggest the Hobbes argument about law enforcement has merit, regardless of whether a government is grounded in a social contract or not, as long as criminals bear some risk of punishment for their crimes. Thus, a government with a judicial system that is reasonably honest and diligent tends to diminish crime. This is partly because persons at the margin join the non-criminal economy, which tends to increase output and, often, wage rates for reasons developed in the next section.

IV. Crime and the Extent of Markets

In addition to the effects noted in the previous sections, reductions in crime rates often reduce losses and uncertainty associated with property ownership and other market transactions for firm owners and for their customers. In such cases, reductions in crime rates further increases economic prosperity through effects on risks that affect the supply of and demand for goods and services in the community of interest.

Crime and the Theory of the Firm

Consider, for example, a product which may be stolen between the manufacturing stage of production and its sales to a customer. After which, there is a chance that it will be stolen from the purchaser of the good.

Let us first consider how theft affects a firm's optimization problem. Suppose that every unit produced by Acme is subject to theft before it is sold, with probability F^F. Assum that the probability of such thefts is an increasing function of the crime rate characterized by 13.7, $F^F = f(G, w^0)$. Suppose also that its product is sufficiently unique that it faces a downward sloping demand curve for its product, $Q^D = b(P, P^0, Y)$, where P is the selling price of the good, P^0 is the price of a good substitute for its product, and Y is average consumer income for the group that purchases Acme's type of product.

Acme's output decision is affected by internal theft because this affects the expected revenues realized by producing its product. To see this, we have to characterize Acme's expected profit maximizing output. The implicit function theorem can be used to characterize its best selling price for a given output as $P=p(Q, P, P^0, Y)$. Assume that Acme produces its good with a single input production function, $Q = q(L)$, and that it purchases it labor in a competitive market. Using the implicit function theorem, we can characterize the firms use of labor as $L = l(Q)$ and its cost function as $C = w\, l(Q)$. The firm's expected lost of output between production and sales is $F^F Q$—the probability of theft times the output produced.

Acme's expected profit function is thus:

$$\Pi^e = p(Q, P, P^0, Y)(1 - F^F)Q - wl(Q) \qquad (13.10)$$

In this case, Acme's revenue is an expected value because, on average, $(1 - F^F)$ of the quantity produced disappears between its production and sale. Differentiating with respect to Q and setting the result equal to zero allows Acme's expected profit maximizing output to be characterized as:

$$\Pi_Q^e = P(1 - F^F) + P_Q(1 - F^F)Q - wL_Q = 0 \;\equiv\; H \;\; at\; Q^* \qquad (13.11)$$

This first order condition is similar to models of firm decision making developed in the first part of the book except for the term that characterizes the pilferage rate, F^F. To characterize the effect of an increase in the probability of theft between the point where the product is made and sold, we first use equation 13.11 and the implicit function theorem to characterize the firms output decision as:

$$Q^* = s(P^0, Y, w, F^F) \tag{13.12}$$

Then use the implicit function differentiation rule to determine the effect of pilferage on output.

$$\mathrm{Q}^*_{F^F} = \frac{dH/dF^F}{-dH/dQ} = \frac{-(\mathrm{P} + \mathrm{P}_Q\mathrm{Q})}{-\Pi_{QQ}} \quad < 0 \tag{13.13}$$

The sign of the numerator is determinative as usual if the profit function is strictly concave. However, the numerator cannot be signed in the usual way because the first term inside the parentheses is positive and the second is negative. Note, however, that the term inside the parentheses is the marginal revenue function for a firm of this type without pilferage. The term inside the parentheses thus must be positive in the range of interest; thus, the overall derivative of the effect of pilferage on production is negative. As the risk of theft increases, production falls, prices rise (recall that the firm's demand curve is downward sloping), and the demand for labor decreases for every firm affected by that risk—even if firms are risk neutral decision makers, as assumed.

Crime and the Theory of the Consumer Behavior

The demand side of the market is fundamentally similar. Consider the case where a consumer, Al, purchase some units of a good that have a probability being stolen equal to F^C. The expected utility associated with a purchase of Q_1 units of the good 1 is thus $U^e = (1 - F^C)U(Q_1, Q_2) + F^C U(0, Q_2)$. The usual budget constraint is sufficient for this model, $W = P_1Q_1 + P_2Q_2$. The budget constraint implies that $Q_2 = \frac{W - P_1Q_1}{P_2}$. After substitution, the expected utility function is:

$$U^e = (1 - F^C)U\left(Q_1, \frac{W - P_1Q_1}{P_2}\right) + F^C U(0\,, \frac{W - P_1Q_1}{P_2}) \tag{13.14}$$

Note that the quantity consumed is zero if all of it is stolen after it is purchased, although a full price was paid for it, so the quantity of good 2 consumed is not affected by the theft of good 1 (although in a richer model it could be). Differentiating with respect to Q_1 allows the optimal purchase of good 1 to be characterized.

$$U^e_{Q_1} = (1 - F^C)\left[U_{Q_1} + U_{Q_2}\left(\frac{-P_1}{P_2}\right)\right] + F^C\left[U_{Q_1} + U_{Q_2}\left(\frac{-P_1}{P_2}\right)\right] = 0 \equiv H \quad at\ Q_1^* \tag{13.15a}$$

Which can be rewritten in terms of expected subjective marginal benefits and costs as:

$$[(1-F^C)U_{Q_1} + F^C U_{Q_1}] + [(1-F^C)U_{Q_2} + F^C U_{Q_2}]\left(\frac{-P_1}{P_2}\right) = 0 \quad at\ Q_1^* \qquad (13.15b)$$

In the second case (equation 13.15b), the first term is the expected marginal benefit of good 1 and the second term is its expected marginal cost.

In either case, it is important to keep in mind that the quantities inside the marginal utility functions differ according to whether they are mulitiplied by $1-F^C$ (in which case all Q_1* units are brough home or F^C (in which case no Q_1* units of good 1 are brought home. In the latter case, a corner solution would have existed had this theft occurred with certainty, because the marginal benefits realized from good 1 (zero) are below their marginal subjective cost, $U_{Q_2}\left(\frac{P_1}{P_2}\right)$. Because theft would be unavoidable in that case, the quantity of good 1 taken home cannot be increased, but extra purchases of good 1 from reduces consumption of good 2. (That thieves take only good 1 implies that good 1 is much easier to resell and/or of higher market value than good 2). This implies that the term in the second set of brackets in equation 15a is less than zero, This, in turn, implies that than the term inside the first set of brackets must be positive if a Q_1* exists that satisfies the first order condition. Al purchases less of the good than he or she would have in a setting where he or she was certain to bring all the units purchased home for personal use or consumption.

The implicit function theorem implies that Al's demand for good 1 is a function of its price, the price of its best substitute, personal income or wealth, and the probability that it will be stolen.

$$Q_1^* = b(P_1, P_2, W, F^C) \qquad (13.16)$$

The derivatives with respect to P_1, P_2 and W are similar to those in chapter 2. The derivative with respect to the probability of theft is new and is the main interest of this model. The implicit function theorem differentiation rule and equation 13.15a can be used characterized the effect of an increase in the probability of theft on the quantity of good 1 purchased.

$$Q^*_{1\mathrm{F}^C} = \frac{H_{F^C}}{-H_{Q_1}} = \frac{-\left[U_{Q_1} + U_{Q_2}\left(\frac{-P_1}{P_2}\right)\right] + \left[U_{Q_1} + U_{Q_2}\left(\frac{-P_1}{P_2}\right)\right]}{-U^e_{Q_1Q_1}} < 0 \qquad (13.17)$$

The denominator will be positive if the expected utility function is strictly concave, which it will be if the utility function is strictly concave as assumed in neo-classical models of consumer behavior. The numerator combines positive and negative terms, and the overall result is determined by the magnitude of the differences between the net marginal utilities with and without theft.

As in the previous case, one has to make use of other information about the terms in the parentheses than their individual signs, because these provide information about the relative magnitudes of those terms inside each pair of parentheses. Note that these two terms are exactly those discussed after the first order conditions were developed. The term in the second set of parentheses is negative and the term in the first set of parentheses is positive. This implies that Al purchases fewer units of good 1 as the probability of it being stolen increases. And it is quite possible that there is a probability of theft that is high enough that Al purchase no units of good 1, in which case a "corner solution" exists.

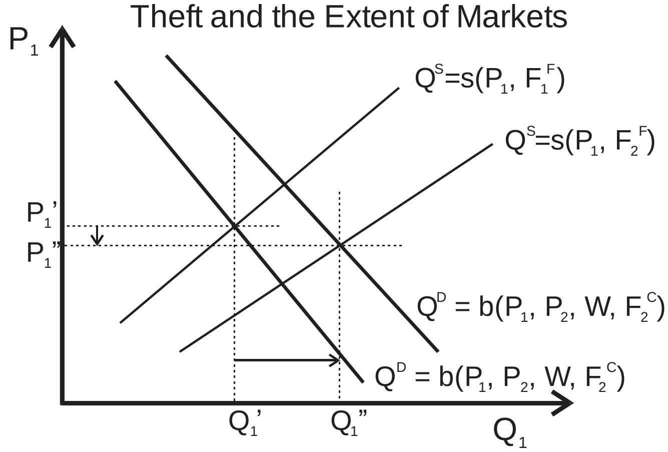
Crime, Law Enforcement, and the Extent of Markets

Together the above analyses of the effect of theft on both supply and demand functions implies that markets expand when laws against thievery are diligently and honestly enforced. In such cases, as more resources or better juridical institutions are developed, thievery falls and markets expand.

Figure 13. 1 provides a geometric illustration of these results, with the results of the above taken to a perfectly competitive market with upward sloping supply curves and downward sloping demand curves. Theft rates are assumed to have fallen from $F^F{}_1$ to $F^F{}_2$ and from $F^C{}_1$ to $F^C{}_2$ in the illustration. The competitive price taking case is illustrated rather than the price-making case, because the geometry is simpler to depict and interpret, and qualitatively the same.

The case depicted clearly illustrates why reductions in thievery for whatever reason tends to expand markets, making both firms and consumers better off—although not the thieves.

Figure 13.1: The Probability of Theft and the Extent of Markets



The microeconomic analysis above illustrates why markets tend to expand when property claims are deemed to be legitimate, and ownership rights can be lawfully transferred from one individual or group to another through voluntary exchange, whereas shifts of property through thievery are punished by law. Market output increases because less time is committed to unproductive activities and because the scope for exchange increases as risks fall for consumers and firms. However, not all crimes involve theft in the sense analyzed to this point in Chapter 13. There are other behaviors that tend to be subject to criminal and civil law penalties that have more subtle effects on the extent of markets.

V. A More Subtle Type of Crime Fraud

> Most foolish of all, and the meanest, is the whole tribe of merchants, for they handle the meanest sort of business by the meanest methods, and although their lies, perjury, thefts, frauds, and deceptions are everywhere to be found, they still reckon themselves a cut above everyone else simply because their fingers sport gold rings. There are plenty of sycophantic friars too who will sing their praises and publicly address them as honorable, doubtless hoping that a morsel of these ill-gotten gains will come their way. Erasmus, Desiderius. (1509). *In Praise of Folly* (Kindle Locations 1681-1684). Penguin Books Ltd. Kindle Edition.

This section explores how another behavior often considered to be immoral or criminal may also undermine markets, namely fraudulent claims made by buyers or sellers. One might at first imagine that fraudulent claims would simply be rejected by potential buyers or sellers, who would immediately recognize the false claims being made on either or both sides of a market transactions. This would be true, for example, if the neoclassical assumptions about informed buyers and sellers were entirely accurate. However, if the existence of ignorance on either side of a market transaction is acknowledged, such false claims may be made and to some extent believed—or if not the mere possibility of fraudulent claims may eliminate or greatly reduce the scope for market transactions as demonstrated in this chapter.

Both sellers and buyers may make misleading claims, but we'll focus on those of sellers rather than buyers. The logic and consequences of fraud by buyers is very similar to that analyzed for sellers. As before, we'll first use elementary game theory to illustrate the essential logic of the problem and then develop a model grounded in neo-classical understandings of market equilibria.

Fraud in a Trading Game

Suppose that a seller is selling a type of product for which two versions exist. One is a low-cost product that either tastes bad or breaks down within a few days of use. The other is one that either tastes good or is extremely durable. Assume that the products are indistinguishable at the point of sale, but that the low quality—less tasty or durable—version of the good is far less costly to produce than the higher quality—more tasty or more durable—version of the product. Because of those two properties, sellers can potentially realize much greater profits by falsely claiming that they are selling high quality goods, while actually selling the low-quality units. Unlike the cases analyzed in chapter 7, where poor quality was an accidental result of random errors in production or the uncertain effects of weather, in this case, sellers may intentionally sell the lower quality units in the pursuit of higher profits by pretending that they are of high quality.

Table 13.2 illustrates this choice setting. In the context of voluntary exchange, an offer by a seller has to be accepted by the prospective buyer if a sale is to take place. In the setting of interest, the making off offers and accepting them are both costly activities. Both require at a minimum time and attention, and both making and assessing offers may also require various materials or transportation costs to be borne.

Table 13.2: The Dilemma of Fraud

		Bob (buyer)	
		Accept or solicit offer	Ignore all offers
Al (seller)	Fraudulent offer	(A ,B) (3, –3)	(A , B) (–1, 0)
	Honest offer	(2, 2)	(–1, 0)
	Do not make offers	(0, –1)	(0, 0)

Although neither participant in the trading game has a pure dominant strategy, there is only a single Nash equilibrium—namely the no-trade equilibrium in the lower righthand corner of the matrix. Gains to trade are possible, but the temptation to engage in fraudulent offers are sufficient that the honest offer cell is not a stable outcome.

It bears noting that the "money back guarantee" solution to the uncertain quality case explored in chapter 7 is not a solution to the problem of fraud, because that is exactly the kind of service modelled in table 13.2. It is impossible for purchasers to distinguish between truthful guarantees and non-truthful ones.

Legal penalties for fraud, however, are one possible solution. If the expected fines for fraudulent offers are sufficient, the temptation to engage in them may disappear, as with legal system that imposes an expected penalty greater then 1 (F^e>1)in table 13.3 below, which is sufficient to eliminate the higher profit from the fraudulent offer.[3]

Table 13.3: The Dilemma of Fraud

		Bob (buyer)	
		Accept or solicit offer	Ignore all offers
Al (seller)	Fraudulent offer	(A ,B) (3-F^e, –3)	(A , B) (–1- F^e, 0)
	Honest offer	(2, 2)	(–1, 0)
	Do not make offers	(0, –1)	(0, 0)

However, such a penalty is not sufficient to guarantee that trade takes place, but it does cause the trading cell (shaded in green) to become a possible Nash equilibrium.

Degrees of Misrepresentation—the Continuous Case

In the continuous version of this choice setting, a mix of defective and high-quality units may be brought to market and the probability that particular units are of low quality is unknown to buyers, but known to sellers.

[3] In this context, such penalties may eliminate the temptation for fraud without generating a market for the good in question. The bottom 2x2 game, has two equilibria, one where the gains are realized, and the other where they are not. But this is still an improvement over the case where the mutual gains to trade cell is never an equilibrium.

Were the probability known, the demand side of the market would be similar to the risky purchase of goods that varied in quality unintentionally. Al would purchase units of a good have a probability, F, of being of low rather than high quality The expected utility associated with a purchase of Q_1 units of the good 1 would be $U^e = (1-F)U(Q_1^H, Q_2) + FU(Q_1^L, Q_2)$. The usual budget constraint would apply, $W = P_1Q_1 + P_2Q_2$. In a two-good model, the budget constraint implies that $(Q_2 = \frac{W-P_1Q_1}{P_2}$. After substitution, the expected utility function is:

$$U^e = (1-F)U\left(Q_1^H, \frac{W-P_1Q_1}{P_2}\right) + FU(Q_1^L, \frac{W-P_1Q_1}{P_2}) \tag{13.18}$$

Differentiating with respect to Q_1 allows the optimal purchase of good 1 to be characterized.

$$U_{Q_1}^e = (1-F)\left[U_{Q_1} + U_{Q_2}\left(\frac{-P_1}{P_2}\right)\right] + F\left[U_{Q_1} + U_{Q_2}\left(\frac{-P_1}{P_2}\right)\right] = 0 \equiv H \quad at\ Q_1^* \tag{13.19}$$

The implicit function theorem implies that Al's demand for good 1 is a function of its price, the price of its best substitute, personal income or wealth, the quality of the two possible types of good 1 and the probability that a poor-quality item is mistakenly purchased.

$$Q_1^* = b(P_1, P_2, W, F, Q_1^H, Q_1^L) \tag{13.20}$$

This demand function would be essentially identical to the one analyzed in chapter 7, except that a fraudulent seller would manipulate F to maximize his or her profits given that demand curve, rather than produce defective units accidentally.

However, in a setting where fraud is possible, not only are the quality levels unobservable at the point of sale, but their relative frequency is unknown to purchasers—indeed a fraudulent seller will attempt to persuade its consumers that the probability of low-quality units is far lower than it actually is—while acknowledging that some defective units "unfortunately" exist. This will increase sales, by reducing the risk perceived by purchasers.

In cases in which purchasers know the average defect rate and its variance, but not that of particular sellers, a seller may profit by having a higher than average defect rate, but one that is not discernable by a single customer—even after the purchase—because of the variance in a consumer's estimate of the average defect rate. If consumers can only detect differences in quality that are two standard deviations below the norm, a pragmatic firm owner might attempt to produce a mix of high and low quality units that are just less than that threshold for detection. If this pattern of behavior became common among firms, the result would be a declining time series of average quality, as pragmatic sellers adjust the mix of goods brought to market to exploit buyer confidence intervals. The end result would be that average quality falls through time and the market gradually disappears, as in the classic Akerlof's classic (1970) paper where he developed the so-called Lemons dilemma.[4]

In cases where sellers are not constrained by seller estimates, the seller may be able persuade the typical buyer that essentially all the units are of high quality, in which case the seller would be inclined to produce only low-quality units, and profit from the higher markups of those units by misleading his, her, or their buyers as in the game matrix above. If consumers come to realize that in many, perhaps most, cases in which the quality of goods cannot be recognized at point of sale they are "patsies" for fast talking salesmen, they will simply stop purchasing such goods unless the low-quality goods yield benefits greater than their price. The result would be a no-trade equilibrium similar to that of Table 13.2.[5]

A well-enforced law that punished sellers for making fraudulent or significantly misleading claims would tend to reduce the extent of false claims made by pragmatic sellers, and markets for goods whose quality cannot be reliably assessed at the point of sale would emerge and flourish. As in the analysis of property rights, a well-conceived and well-enforced criminal law can expand the domain of market exchange and increase the density of market networks—both in final goods markets and in intermediate goods markets.

[4] It bears noting that if such pragmatic sellers claim that their product mix is accidental, buyers may ask for a "money-back guarantee" and be willing to pay a premium for such insurance and there may be sufficient pressure that firms do so—but pragmatic sellers may not always make good on their guarantees. They may, for example, insist on evidence, challenge buyer claims of poor quality, endlessly postpone reimbursements, and so forth.

[5] An entrepreneurial firm that believed it could develop a reputation for making honest offers might avoid the temptation to profit from fraudulent offers, partly for that reason, and if successful be able to charge a premium for its product over those sold by firms without a reputation for quality. So, laws are not the only possible escape from the dilemma of fraud, but it does require the ability of consumers to accurately assess "reputations" among firms in some way.

XXIV. A Few Conclusions

Chapter 13 illustrates why at least some well-enforced laws can increase the extent of markets, and it also illustrates how rational choice models can be used to characterize relationships between legal systems and the extent of markets—a relationship that is not mentioned in the core neoclassical models or many economic textbooks. However, as with extensions to risk and entrepreneurship, analysis of such neglected relationships can often shed light on significant determinants of market outcomes. In the case of law enforcements, regional differences in laws and in the quality of law enforcement may extent the extent of markets a point in time and within a region through time. Moreover, relatively few new assumptions are required to examine the economic implications of laws on the extent of market networks. Indeed, arguably what is need is dropping an assumption—namely that all market-relevant conduct is fundamentally voluntary. No coercion takes place, no theft, and no fraudulent claims.

Insofar as differences in laws and the manner in which laws are enforced occur within a nation through time and differ among nations at point in time, this variation provides another partial explanation for variations in the extent and growth of markets—one that is neglected by the core models. Microeconomics clearly needs to go beyond the lean neoclassical models of price theory if its aim is to account for the existence of markets and differences among them. A prerequisite for the existence of markets is that ownership rights exist, and they can be transferred from one person to another through voluntary transactions. Law and law enforcement is one way to account for both tradeable property rights and the possibility and relative frequency of voluntary exchange, as developed in this chapter.

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