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Puzzles

On the Economics of Crime and Confiscation

Ted Bergstrom

The puzzles in this column focus on the issues of crime and confiscation. Answers to all three puzzles can be found at the end of the column. As mentioned in the Spring 1990 issue, the editors are currently searching both for a new puzzles editor and for new puzzles. If you are interested in the job, this is your chance to apply by sending in a sample column with a selection of your favorite puzzles (with answers, please). Until the torch is actually passed, please keep sending your answers, comments, favorite puzzles and T-shirt size to: Barry Nalebuff, “Puzzles,” Yale School of Organization and Management, Box 1A, New Haven, CT 06520.

Problem 1: The Microeconomics of Elephant Tusks and Rhinoceros Horns

The horn of the rhinoceros is prized in Japan and China for its putative aphrodisiac properties. This has been unfortunate for the rhinoceroses of East Africa. Although it is illegal to kill a rhinoceros in the game parks of Kenya, the rhinoceros population has been almost totally depleted by poachers. The price of rhinoceros horn is so high that a poacher can earn about half a year’s wages by killing a single rhinoceros. South Africa also has a rhinoceros population in its game parks. The South African government has managed to police these parks so effectively that the rhinoceros herds have prospered. In fact, some of the South African rhinos have to be “harvested” in order to prevent overpopu-

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lation. According to South African authorities, the horns collected from animals which are either “harvested” or die from natural causes are stockpiled or destroyed. South Africa, they say, does not want to “contribute to international crime” by selling these horns.

Some months ago, *The New York Times* printed a memorable picture of a bonfire in which tons of confiscated elephant tusks were publically burned by the Kenyan government. If the government’s objective is to minimize the number of rhinoceroses and elephants that are slaughtered for their horns and tusks, would it be better to destroy (or stockpile) confiscated material or to sell it on the open market? Use demand and supply curves to illustrate your answer.

Probably you drew an upward sloping supply curve for elephant tusks and rhinoceros horns. This is not unreasonable. But a case can be made that these supply curves slope downwards over a relevant range of prices. Suppose that excessive hunting of elephants reduces the population and hence the annual yield of tusks. The steady-state yield of elephant tusks will be an increasing function of the number of hunters for small numbers of hunters and a decreasing function as the number of hunters becomes large. Since hunting of elephants (or of rhinos) is a problem of an overexploited commons, it may be that in equilibrium, each hunter has a negative effect on the overall yield.

Suppose, for example, that the steady-state harvest of elephant tusks is related to the annual amount of labor expended on elephant hunting by the equation $h = l - l^2$. Since there are no property rights to the commons, hunters will enter the industry until the money value of the average product of labor is equal to the wage that hunters could earn elsewhere. Let the price of elephant tusks be p and the alternative wage of elephant hunters be w . Show that the supply curve of elephant tusks slopes upward at low prices and downward at high prices.

If the supply curve is downward-sloping over the relevant range, does this change the answer as to whether destroying confiscated tusks and horns is good or bad for elephants and rhinos?

Problem 2: The Spoils of Drug War

Governments try to prevent trade in rhinoceros horns or ivory not because consumption of aphrodisiacs or piano keys is thought to be harmful to consumers, but rather because production of these goods is bad for rhinoceroses and elephants. In contrast, production of marijuana or coca plants is a harmless pastoral activity. It is consumption of these products that governments wish to prevent. This different objective suggests that the appropriate way for the government to intervene may also be different.¹

¹Grossman and Shapiro (1988) discuss the effects of destroying confiscated goods in a situation where yet another set of social objectives applies—the case of counterfeited products.

Suppose that the government interferes in the illegal drug market only by intercepting and confiscating a fixed fraction of the drugs sold illegally. If the government confiscates (say) half of the drugs that reach the market and resells them on the open market, what will be the effect on market price and on demand? Suppose that instead of reselling confiscated drugs, the government destroys them. What then will be the effect on market price and demand? Demonstrate the effects on a diagram, first for the case where the supply schedule is horizontal. Finally, analyze the case where the supply schedule is upward-sloping.

Problem 3: Read My Lips, George Schultz

Could the government legalize the sale of drugs, but tax them so heavily as to keep consumption near current levels? If the tax were high and enforcement slight, an illegal trade would probably arise to avoid the tax. Supply and demand analysis can provide useful clues about tax and enforcement levels that would be compatible.

Let us take a stab at this problem by making some strong assumptions. Assume that current drug intervention takes the form of confiscating and destroying half of the drugs that are supplied. Assume also that legally marketed drugs are perfect substitutes for illegally marketed drugs. Suppose that the government imposes an *ad valorem* tax of slightly less than 50 percent of the market price and continues to pursue enforcement policies that result in confiscation of half of the illegal drugs supplied. What would happen to legal and illegal drug consumption, and to government revenues and expenditures? Use a supply and demand diagram to show what happens to total drug consumption. Suppose that the government used the revenue from the sales tax to buy drugs and destroy them. On your diagram show what happens to total consumption.

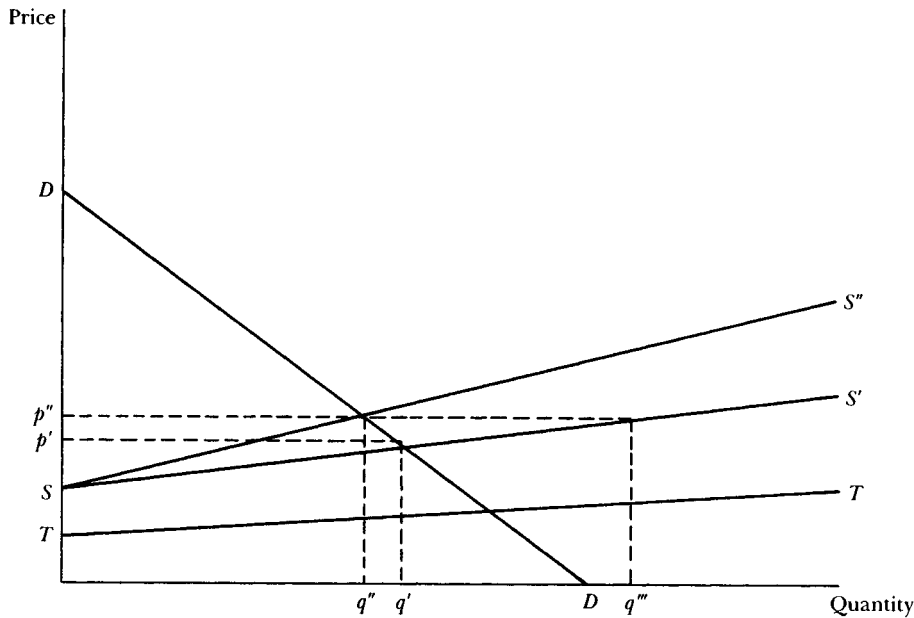
How would the analysis change if consumers prefer legal to illegal drugs because of better quality control and less dangerous shopping conditions? How does the analysis change when confiscation is not the only punishment for illegal sales of drugs?

Answers

Answers to Problem 1

Government sales of confiscated (or harvested) horns and tusks will shift the supply curve to the right and depress the equilibrium price. Assuming that the number of animals killed by poachers is an increasing function of price, this option should be preferred to destroying or stockpiling confiscated material. The story is illustrated in Figure 1. The supply schedule in the absence of

Figure 1
The Effect of Reselling Confiscated Material



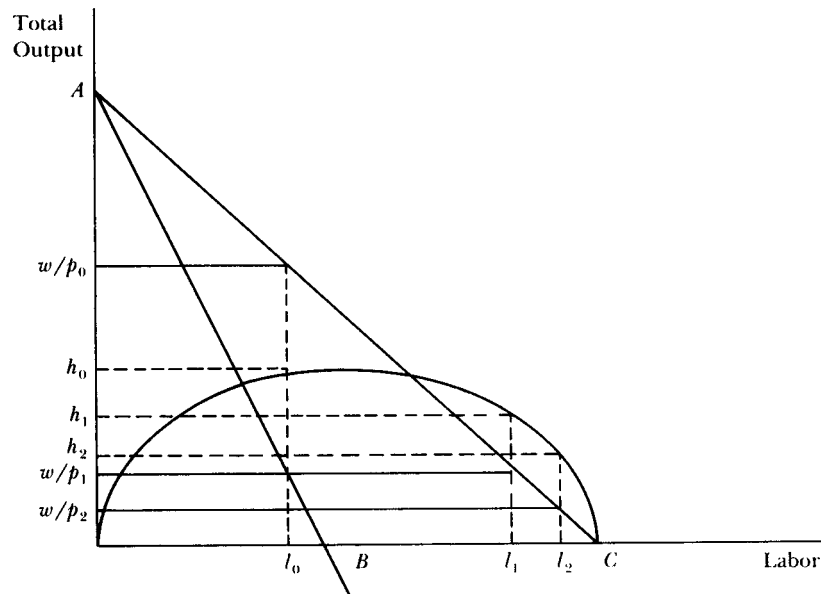
government interference is the line TT. If the government confiscates half of the horns (tusks) that are illegally traded and resells the horns on the market, the supply schedule shifts vertically to SS'. The curve SS' is the curve that is exactly twice as high above the horizontal axis as TT, since poachers have to kill two animals in order to realize the proceeds from one. In this case, the market price will be p' and the quantity sold will be q' . If the government destroys the confiscated materials, then only half of the horns and tusks that are captured will reach the market. The supply schedule to the market would be SS''. The number of horns that reach the market is $q'' < q'$, but the number of animals that are killed is $q''' > q'$, since, when the confiscated horns are destroyed, two animals are killed for every horn that reaches the market.

If the amount of ivory harvested is $h = l - l^2$, then the marginal product of labor is $1 - 2l$ and the average product of labor is $1 - l$. In equilibrium, the value of the average product of labor equals the alternative wage when $w/p = 1 - l$. Therefore the amount of labor devoted to elephant-hunting is $l(p) = 1 - w/p$. Where $h(p)$ is the amount of ivory supplied at price p , $h(p) = l(p) - l(p)^2$ and $h'(p) = (1 - 2l(p))l'(p) = (2w/p - 1)w/p^2$. From this expression, we see that $h'(p)$ is positive for $p < 2w$ and positive for $p > 2w$.²

The same story is told graphically in Figure 2. The parabola is the graph of total output as a function of the amount of labor. The lines AB and AC

²The possibility that a common resource will be exploited to the point where the marginal product of inputs is negative is discussed by Colin Clark (1976) in his analysis of "overfishing."

Figure 2
When the Supply of Material Slopes Down



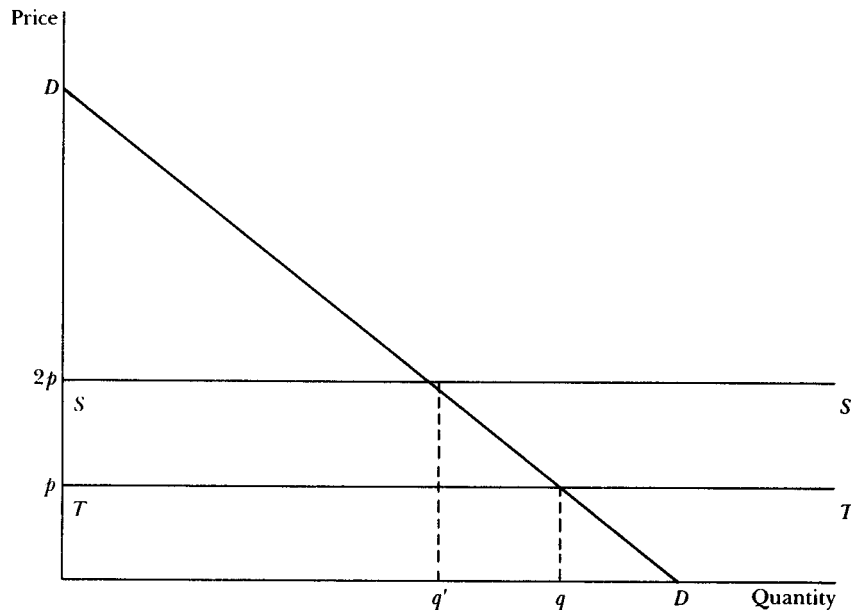
represent the marginal and average products of labor respectively. When the price of ivory is p_1 , the number of hunters will be l_1 and output will be h_1 . Now try a higher price, $p_2 = 2p_1$. At this price, the number of hunters will be $l_2 > l_1$ and total output will be $h_2 < h_1$. Therefore the supply of tusks is a decreasing function of their price when prices are high. At a low price like p_0 , the marginal effect of hunters on total output is positive and the supply of tusks will increase for small increases in price.

If the supply schedule of tusks is downward sloping, then starting from a stable equilibrium, the effect of reselling confiscated materials is to lower price. This will increase the total supply of tusks. But the increase does not come at the cost of a reduced elephant population. Indeed the lower price reduces the number of hunters which leads to an increase both in the number of elephants and the number of tusks. It follows that reselling confiscated tusks is good for elephants no matter which way the supply curve slopes.

Answers to Problem 2

Suppose that in the absence of government interference, the supply curve is horizontal at price p . In Figure 3, this supply curve appears as TT. If the government confiscates half of the total production of drugs, then for suppliers to receive an expected return of p , the price must be $2p$. Thus, the government's confiscation shifts the supply curve up from TT to SS. Whether or not confiscated drugs are resold, confiscation increases the equilibrium price from p to $2p$ and reduces equilibrium consumption from q to q' . If the government

Figure 3
The Effect of Confiscation on Supply



destroys confiscated drugs, then the quantity of drugs produced will be $2q'$, since 2 units must be produced for each unit consumed. If the government resells the confiscated drugs, total production will be only q' . In this case there is a strong case for reselling the confiscated drugs, since consumption is the same in either case, but resources are saved for other productive purposes if confiscated materials are resold. Indeed, these resources fall into the hands of the government as revenue from the resale of drugs.

If the supply curve is upward-sloping, then confiscation and resale will raise price and reduce consumption, but confiscation and destruction of confiscated drugs will raise price and reduce consumption even more. We can see this by looking again at Figure 1. If drugs are confiscated and resold, the equilibrium price is p' and the quantity is q' . If the confiscated drugs are destroyed, the equilibrium price is $p'' > p'$ and the equilibrium quantity consumed is $q'' < q'$, while equilibrium production is $q''' > q'$.

Answers to Problem 3

If the government confiscates half of the drugs that are sold, then at a tax rate of 50 percent, a seller will be indifferent between selling legally with the tax and selling illegally with the possibility of confiscation. The illegal sector would shut down completely if the tax rate is even slightly lower than the confiscation rate.

Again we can look at Figure 1. A tax rate of a little less than half the market price shifts the supply curve from TT to a curve just a little lower than SS'. Recall that SS' is the supply curve when there are no legal private sales of drugs and the government confiscates half of the illegally supplied drugs and resells them. From a social point of view, the "cost" of legalizing drugs in this way is that consumption rises from q'' to q' . On the other side of the ledger, the government collects tax revenue equal to $p'q'/2$.

If the government uses its sales tax revenue from a 50 percent tax to buy and destroy drugs, then for every unit of drugs that reaches demanders, two must be produced. This shifts the supply curve back to SS'' where at any market price, exactly half as much drugs reach the market as with the supply curve SS'. The result is the same as that when there are no legal drugs and half of the drugs that are produced are confiscated and destroyed.

Notice that if the supply curve of drugs is horizontal, then purchasing and destroying drugs does nothing to increase the price. Indeed the more nearly horizontal the supply curve is, the less effective a policy would be. Even though government purchase and destruction of drugs may not be a cost-effective device,³ it is interesting to see that using the revenues from a sales tax in this way offers a balanced-budget means of legalizing drugs and maintaining the old street price.

A benefit of legalization is the likely reduction in the amount of resources needed for drug enforcement. The curves in Figure 1 are drawn on the assumption that authorities will confiscate half of the drugs that are sold illegally. Of course it would not be possible to eliminate all of the resources devoted to drug enforcement and maintain this probability of confiscation. But it must be that if the amount of illegal activity is greatly reduced, then the amount of resources needed to maintain the old confiscation rate will also be reduced.

If users prefer legal to illegal drugs, then legalization might increase consumption even if drugs were taxed so as to maintain the old street price for illegal drugs. But such a preference would allow the government to charge an even larger tax on legal drugs. If consumers are willing to pay a premium for legal drugs over illegal drugs, our earlier analysis still holds when the government adds to the previously considered tax an amount of money equal to this premium.

In the real world drug enforcement includes punishments other than confiscation; for example, there are jail terms for some convicted offenders. Furthermore, it appears that the police refrain from protecting the lives and property of drug dealers. In this environment, it is more difficult to determine how large an illegal sector would be sustained for various tax levels. Not all

³Come to think of it, maybe drug enforcement policies should be put in the hands of the U.S. Department of Agriculture. Nobody laughs at them when they propose to buy and stockpile or destroy agricultural products to increase the market price.

suppliers would share the same view of the costs of supplying drugs illegally rather than legally. Under these circumstances, the question about whether the legal market crowds out the illegal market is not an all-or-nothing matter, but rather depends in a continuous way on the tax level.

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