CRIME PREVENTION AND THE COSTS OF AUTO THEFT: AN ECONOMIC ANALYSIS

by

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Abstract* *The total cost of auto theft to the U.S. in 1985 is estimated at $6 billion at current prices, or about $45 per automobile per year. On the basis of this estimate, it is calculated that it would be cost-effective for society to invest a few hundred dollars per car in built-in security to prevent auto theft. In practice, there is very little incentive for individual owners to prevent auto theft, since most of the costs fall in the form of insurance premiums and government expenditures rather than in the form of losses falling to individual owners. It is argued that there should be government-mandated standards of design security applied to all automobiles, since the private market is inadequate to the task of providing an optimal level of theft security.*

INTRODUCTION

The aim of this paper is to assess the costs of auto theft, identify the parties on whom those costs fall, and explore the implications for the introduction of cost-effective means of theft prevention.

Auto theft has been an under-researched topic, but there are signs that this is now changing, as indicated in a series of studies by Mayhew (1990), and by Clarke and Harris (1992a, 1992b) among others. One reason for the increasing interest may be a recognition that auto theft, while not generating the kind of fear that is provoked by violent crime, is both very common and very costly. In 1987, there were just under one and a half million thefts of motor vehicles in the U. S. Although there were three to four times as many burglaries, average burglary losses

were considerably less. In 1987, there were just under 900,000 motor vehicle thefts resulting in gross losses of more than $500, as compared with just under 130,000 burglaries involving losses of this order (U.S. Department of Justice, 1989).

Vehicle theft is only part of a wider category of crime involving vehicles as targets. In 1989, 38% of reported larceny-thefts (other than motor vehicle theft) were either thefts from vehicles, or thefts of motor vehicle accessories. Thefts in which vehicles or their contents were targets represented nearly half of all reported larceny-thefts in 1989 (U.S. Department of Justice, 1990). Clarke and Harris (1992a) argue that the most promising potential means of preventing auto theft lies in enhanced measures of physical security. On this assumption, prevention measures designed to reduce the risk of vehicles becoming targets of crime have the potential to affect nearly half of all recorded theft.

An economic assessment of the costs of auto theft is an important foundation for such prevention measures. It should demonstrate whether or not any proposed measure of theft prevention is likely to be cost-effective, as well as helping to determine the incentives that fall on the different parties, including both automobile owners and manufacturers, to invest in prevention.

Few systematic attempts have been made to estimate the cost of crime. Those that have occurred—such as estimates by the President's Commission on Law Enforcement and Administration of Justice (1967) and the U.K. Home Office (1988a)—have been very general. The only specific study of the cost of auto theft uncovered by the present author was a brief unpublished study by Brobeck (1983), which estimated the total costs of auto theft for 1981 as "at least $3.3 billion."

Estimation of the costs of auto theft is subject to the limitations of the available data, as well as the theoretical difficulties of identifying the social cost of inequity and risk. It follows that the quantitative estimates offered in this paper rely on a number of assumptions, and must be considered as order-of-magnitude estimates only. The main contentions of this paper, advanced in the conclusion, rest not on the precise figures given as estimates, but on the orders of magnitude involved. The policy conclusions can therefore be maintained despite alterations in the assumptions used to estimate costs.

The study that follows is concerned only with theft of automobiles. It will not address the more common, but less costly crime of theft from vehicles.

THE COSTS OF AUTO THEFT

Much of the available data are concerned with vehicle theft, covering pickups and vans as well as automobiles. (These data also include trucks, but very few of these are stolen.) Given that pickups and vans are fairly similar in value to automobiles, the estimation assumption used here has been the simplest available—that the costs of vehicle theft per vehicle stolen are the same for automobiles as they are for the entire vehicle category. In 1985, 75% of vehicle theft was auto theft, implying that 75% of the cost of all vehicle crime was attributable to auto theft (U.S. Department of Justice, 1986).

The cost of auto theft will be assessed for the reference year of 1985, a year for which a wide variety of data are available. The aim of the exercise is to establish the relative order of magnitude of different costs. These orders of magnitude will not have changed significantly in the period since 1985. The costs (including the negative costs, or benefits) of auto theft will be assessed according to the different parties to whom the costs fall. The categorization will be as follows:

Car owners at risk of auto theft

Victims of auto theft

The police and the criminal justice system

Offenders

Society-at-large.

Car Owners At Risk of Auto Theft

Under this heading will be considered "precautionary" costs—those incurred by car owners because they are at risk of car theft. These may be distinguished from the "victim" costs, which will be considered below, and which fall to the relatively small number of actual victims of auto theft. Precautionary costs will be incurred either to reduce the impact of car theft should it occur, or to reduce the risk of car theft in the first instance. The former category will include the cost of theft-related insurance premiums, while the latter will include the cost of crime prevention measures.

Theft-related Insurance Premiums

A large proportion of the losses resulting from auto theft are subject to insurance. Automobile insurance policies usually "package" the theft element of insurance cover along with fire, personal liability and accident provision. The 1985 cost of fire and theft insurance per automobile was $92 *(Statistical Abstract of the United States,* 1987), on

the basis of a $100 deductible policy. Clearly, only a proportion of this will be attributable to the theft element of cover, and a proportion will relate to theft *from* vehicles, rather than to theft *of* vehicles, with which we are concerned here.

The element of insurance premiums attributable to auto theft was estimated indirectly by assessing the total vehicle theft losses subject to insurance. In 1985, motor vehicles valued at $4.72 billion were stolen, while recovered vehicles were valued at $3.04 billion indicating a net loss of $1.68 billion (U.S. Department of Justice, 1986). Applying the assumption discussed at the outset—that 75% of vehicle theft costs are attributable to auto theft (proportionately to the representation of auto thefts in the vehicle theft total)—total auto theft losses will amount to $1.26 billion.

In the many theft offenses where the vehicle was recovered and there was no insurance reimbursement, a proportion will have involved some minor damage that will not be large enough to be subject to an insurance claim. Thus, in 1985, 115,000 motor vehicle thefts involved non-zero losses (due to both damage and theft) of less than $ 100 (U. S. Department of Justice, 1987). Assuming that each loss was $50 and not subject to insurance, the total loss from this source will be $57.5 billion. Applying the assumption that auto theft represents 75% of vehicle theft losses, some $43 million of the auto theft losses referred to above will be less than $100 and therefore be uninsured. Subtracting this figure from the total above, some $1.22 billion of auto theft losses will be subject to insurance.

According to industry estimates, some 85% of vehicles are insured *{Statistical Abstract of the UnitedStates* 1982-1983:615). Assuming that this proportion of the value of losses was insured, 85% of $1.22 billion or $1.04 billion of all auto theft losses was fully insured. Uninsured losses will be the difference between this figure and the total losses of $1.26 billion or about $220 million.

In 1985, there were 114.7 million cars in use *{Statistical Abstract of the United States,* 1987). If, as estimated, 85% were insured, some 97.5 million automobiles were insured. The average insured loss per car-year (for all insured cars) is therefore around $10. The average uninsured loss per car-year (for all cars) is about $1.90, but for insured cars the average uninsured loss per car year (attributable to the deductible element in insurance policies) will be very small—around 40 cents.

Published accounts of insurance overhead costs are very unrevealing, mainly because the "loss" category that is published includes the expenses of loss adjustment, and therefore includes more than just paid claims. General estimates of insurance overheads are available in the

insurance literature. Greene (1968) estimates that "the property and liability insurance business would show about 5 per cent of earned premiums as profit and would expect losses to run between 50 and 60 per cent of earned premiums: the remainder would be used for the expenses of doing business." Broadly similar estimates have been made by Mehr and Cammach (1976). These estimates suggest that the cost of premiums will be around twice the cost of all paid claims. Using the $10 figure above as a guide to the average theft insurance claim per vehicle-year, this would suggest a theft-related insurance premium of around $20.

This figure per car can be aggregated into a U.S. total. It has been estimated above that some 97.5 million cars in use in the U.S. were insured against theft, suggesting a total cost of just under $2 billion in 1985. Uninsured losses will be an additional $210 million.

Vehicle Protection Measures

These measures include both built-in and add-on vehicle security. The add-on theft-prevention industry was estimated to be a $400 million market in 1986 *(Consumer Reports,* 1986:658). If built-in vehicle security is of a similar scale, total expenditure for physical measures of vehicle security will be around $800 million dollars. Again assuming that the costs of auto theft are 75% of total vehicle theft costs, automobile security will have cost around $600 million. The average cost per car year will be about $5.

In addition, there will be opportunity costs resulting from the unwillingness of drivers to use their cars or park their cars in areas that are at particular risk of auto theft. These costs are not easily estimable.

Victims of Auto Theft

Costs falling to the victims of auto theft, considered in turn below, will be of four sorts.

(i) Direct uninsured financial losses experienced by victims,
(ii) Opportunity cost of the time taken to deal with the crime,
(iii) Opportunity cost of the temporary unavailability of a vehicle,
(iv) Psychological costs of the victimization experience.

Direct Uninsured Losses

It has been estimated above that there are direct uninsured losses of about $220 million every year from auto theft, or $1.90 per car year.

Opportunity Cost of the Time Taken to Deal with the Crime

In 1985, 297,000 motor vehicle thefts involved the victims in time off from work. Of these, 50% involved 1-5 days off work, and 34% less than one day (U.S. Department of Justice, 1987). If the average loss of work time in those cases was 1.5 days, as seems plausible from these figures, 445,500 working days were lost. In the same year, average weekly earnings were $299 per week in private non-agricultural employment and $386 per week in manufacturing *(Statistical Abstract of the United States,* 1987). Using the mean of these figures as the measure of weekly earnings and assuming a five-day week, loss of earnings will be $30.6 million. Although in some cases employers may grant time off work without loss of pay, the loss will in this case simply fall on the employers rather than on the individual victims. Using the standard estimation assumptions, the costs will be 20 cents per car-year.

Opportunity Costs of the Temporary Unavailability of the Vehicle

Formally, the opportunity costs of the temporary unavailability of a vehicle, following theft, will be the value to the owner of the best possible use to which that vehicle could be put during that period. Almost certainly, one use to which the vehicle would have been put would be to transport the owner to and from work, and the absence of the vehicle is probably the direct cause of absence from work in many cases. Time off work is therefore likely to be a reasonable guide to the disruption to a theft victim's personal, as well as working life as the result of auto theft. This suggests that the personal opportunity costs will be around $30 million. Again using the standard estimation assumptions, the average cost of auto theft from this source per car year will be about 20 cents.

Psychological Costs of Auto Theft

Psychological costs are not easily quantifiable, and no attempt will be made to do so here. On the face of it, one would not expect car theft to impose heavy psychological costs, since the offense does not normally take place in the presence of the victim, and because cars are seen by most people as less private than a home. Consequently, the perceived invasion of privacy following car theft will be less than in the case of burglary. The evidence supports the hypothesis that the psychological costs of auto theft are small, at least in comparison with other crimes. May hew (in press) reports that 55% of those who were victims of car theft in Britain describe the "worst thing about the incident" as being "inconvenience, nuisance and other practical problems," and relatively few respondents mentioned fear, invasion of privacy and other emotional

effects. By contrast, only 14% of those who were victims of burglary described the worst thing about the incident as being inconvenience and other practical problems, and a much larger proportion mentioned emotional effects. The "inconvenience" of car theft has in part already been quantified under the headings of time off work and the opportunity cost of not having a vehicle.

The Cost of Risk

In general, people dislike the uncertainty of rare costly events, as well as the costs themselves, and are prepared to incur additional costs in order to reduce the uncertainty of the costs that will fall to them. This is the basis of the insurance market, whereby people are prepared to incur the administrative costs and profits of the insurance industry in order to spread the costs of risky events across a number of different people.

It follows that the real cost of a given risk of a costly event such as auto theft will not simply be the mathematical product of risk of victimization and average cost of each victimization, but will instead be considerably greater. The cost of risk will therefore represent a substantial additional cost over and above the cost of the uninsured losses in auto crime.

Estimating the cost of risk is not easy. Conceptually, this cost will be the amount that a person would be prepared to pay in order to insure against the risk of loss, over and above the loss expectation (the product of the probability of loss and the average size of an individual loss). A minimum estimate of these costs will be indicated by the difference between theft insurance premiums (or other kinds of insurance premiums) and the average loss expectations of insured persons. This is only a minimum estimate, since insurance premiums would have to rise significantly, holding loss expectations constant, for most people to choose to do without insurance. It has been estimated above that insurance premiums may be twice the expected insured loss. This suggests that the risk cost for uninsured theft losses will be as much again as the initial cost. The uninsured direct costs described above are $1.90 for uninsured direct costs, plus 40 cents for time off work and the unavailability of the vehicle, summing to $2.30 in all. The associated risk costs may therefore be another $2.30, suggesting total costs from this source of $4.60 per car-year.

For insured automobiles, costs will be significantly less. Given average uninsured financial losses of 40 cents, plus 40 cents for time off work and the unavailability of the vehicle, average costs per car-year

will be 80 cents, which together with an allowance for the cost of risk, will sum to $1.60 per car year.

The Police and the Criminal Justice System

Some of the work of the criminal justice system, and therefore some of its costs, are attributable to auto theft. The total cost of the criminal justice system at the federal, state and local levels was $48.6 billion in 1985; $24.4 billion was attributable to police protection, and $24.2 billion to judicial, legal and correctional services (U.S. Department of Justice, 1991). Estimates were made of the proportion of this expenditure attributable to auto theft.

Research on the use of police time has shown that a comparatively small proportion of that time is spent on actual criminal incidents. However, it has also been shown that in Britain, at least in urban areas, the majority of calls to the police concern potentially criminal incidents. A substantial proportion of police time is also spent on patrol, which may be regarded, at least in part, as a response to the level of crime (see Reiss, 1971; Reiner, 1992). With this in mind, an order-of-magnitude assumption was made that half of all police time is associated with the existence of index crime.

It is assumed that time spent on vehicle theft, as opposed to other index crimes, is proportionate to the representation of vehicle theft in index crime arrests. A total of 5.5% of index crime arrests were for vehicle theft in 1985 (U.S. Department of Justice, 1986). It follows on the stated assumptions that 2.75% of total police expenditure, or about $670 million, will be related to vehicle theft. Applying the usual proportionate adjustment, this implies auto theft-related expenditure of $500 million, or $4.40 per car year.

In 1986, the current offense of 1.4% of state prison inmates was theft of motor vehicles. For all its imperfections, this figure represents the most convenient available guide to costs in corrections and probably also in the judicial and legal services which lead to corrections. This implies expenditure of $340 million in this part of the criminal justice system relating to theft of motor vehicles, or $250 million on auto theft, or $2.20 per car year.

Total expenditure by police and criminal justice agencies associated with auto theft will therefore be about $750 million dollars.

Offenders

It has been estimated above that net auto theft loss—the difference between the value of vehicles stolen and those recovered—was $1.26 billion in 1985. This loss is partly attributable to damage to the vehicles stolen and subsequently recovered, and partly to the value of cars permanently lost. The benefits of auto theft to the thieves themselves will include, in the case of cars permanently stolen, the value of the cars themselves, or at least that portion of their value that can be recovered on resale, or dismantling for their parts. This benefit will necessarily be substantially less than the $1.26 billion in total losses. Additionally, there will be a benefit to joyriding offenders, through the excitement and pleasure of driving a car, and perhaps the simple practical value of a temporary means of transport.

There are also costs to offenders, including the risks of apprehension and punishment and the opportunity costs of the time, effort and skill devoted to the task of vehicle theft. The perceived benefits are likely to outweigh the perceived costs—otherwise offenders would have no incentive to engage in crime—but they may only do so by a small amount. If some simple crime prevention device wiped out vehicle theft overnight, vehicle thieves would respond by devoting their energies to other activities; some of these activities might also be criminal, but some would be legitimate, and in this case they might be prepared to accept lower earnings in return for avoiding the risk of punishment. It follows that the net benefits of auto theft to offenders are likely to be much smaller than the gross benefits. Given that the gross financial benefits are likely to be significantly less than a billion dollars, the net benefits to offenders may be estimated at perhaps a few hundred million dollars per year, or a few dollars per vehicle in use.

This net benefit to offenders does not necessarily translate into a net social benefit, for while a society will generally place a positive value on individual benefits, it may choose to withhold this evaluation from benefits obtained by criminal means. As a thought experiment, we may consider the example of a person who has successfully stolen a vehicle for his or her own use. Would we consider it socially desirable for the engine on this car to seize up? Depending on the moral viewpoint adopted, this could be regarded as justice, on the one hand, or pointless vindictiveness on the other. The argument is further complicated by the way benefits to offenders affect third parties. For example, the offender's sick child may need to be driven to the hospital just when the engine seizes up.

This is not the appropriate place to try to resolve this philosophical argument. For the purposes of the evaluation of the social cost of auto theft it will be enough to note two points. First, the net benefit of auto theft to offenders is very much less than the total returns to offenders. Second, it is debatable whether net benefits to offenders represent a benefit to society as a whole.

Society-at-Large

Costs Arising from the Effects on the Vehicle Market

Stolen vehicles have two sorts of impact on the market. First, persons whose cars are stolen commonly replace them with new or used vehicles, while stolen vehicles (which are not exported, written off through damage or chopped of all their valuable parts) reenter the legitimate market as second-hand vehicles. These effects would tend to cancel each other out, except that the supply-and-demand effects may affect different parts of the vehicle market. The net effect will be an increase in the demand for new cars, and an increase in the supply of older cars.

The increased demand for new cars will be met by an increase in supply from manufacturers, and will therefore not affect prices. It has been estimated above that net automobile losses from auto theft could be valued at $1.16 billion. Some of these losses will involve the wholesale loss of an old car that is subsequently replaced with a new vehicle, so that the cost of replacing these losses will be greater than $1.16 billion-^erhaps $1.5 billion—which will represent additional demand for new automobiles and new automobile parts, as well as repair labor. If $1 billion of this total feeds through into additional demand for new cars on manufacturers, and profit margins are 10%, manufacturers will obtain additional profits of $100 million.

The increased supply of older cars will also tend to decrease the price of older cars to bring supply and demand into equilibrium. One effect of vehicle theft on the vehicle market will therefore be to redistribute wealth, reducing the resale value of new cars, and reducing the prices that purchasers of second-hand vehicles will have to pay. The precise direction of this redistribution will depend on the detailed structure of the vehicle market and consumer preferences, but it seems plausible that there will be a small amount of redistribution away from the richer members of society toward the poor.

When vehicles are stolen and "chopped" for their parts, the legitimate market for vehicle parts, supplied by the manufacturers, will lose sales as a result. These lost sales may be set against the increased sales of

parts that occur as a result of vehicle damage from cars that have been stolen for joyriding purposes. The overall effect of car theft on the sale of parts is therefore indeterminate.

Other Costs and Benefits

Other costs that have been attributed to auto theft include accidents caused by stolen cars, the use of stolen cars to commit other crimes, and the capacity of auto theft to lead offenders into other crimes. On the benefits side, auto theft may also displace criminal attention from other targets. No attempt has been made to quantify the costs or benefits attached to these different effects.

Aggregating the Costs of Auto Theft

Table 1 summarizes the estimates of auto theft costs presented in this paper. The five columns correspond to the five parties to whom the costs of auto theft fall. Those costs that can be identified but not quantified are indicated here without any corresponding sum attached to them. Where the "costs" involve benefits to parties, these are represented by a negative sign. The estimated total cost of auto theft to various parties is indicated by summing the contents of each column.

As indicated in the introduction, the total cost to society of auto theft (or any other social problem) may not be accurately indicated by the sum of costs falling on different parts of society. Our judgment of the full social cost will depend in part on whether the distribution of costs is just and equitable. An inequitable distribution of costs is, in effect, an additional cost. These additional equity costs are indicated in Table 1. The equity costs are of two main types.

First, there is evidence of substantial inequity in the distribution of vehicle crime risks. The risk of theft per vehicle owned by black heads of household is nearly three times the risk for white heads of household, and it is more than twice as high for those living in rented accommodation as it is for owner occupiers. These findings indicate that the risk of vehicle theft, as an additional cost of owning a vehicle, falls much more heavily on the poorer sections of society (U.S. Department of Justice, 1987). This means that the costs which fall to victims of crime, and to some extent the precautionary costs, will tend to be inequitably distributed. Additional equity costs have therefore been indicated by a plus sign for these categories of cost. No attempt has been made to quantify them.

It has been argued above that benefits to offenders represent a somewhat dubious benefit to society. The concentration of the benefits of auto theft in the hands of offenders is inequitable by almost any

Table 1: Costs and Benefits of Auto Theft

(Per Vehicle in Use Per Year for 1985* for the Five Major Parties Involved)

Individual victims	Owners of vehicles at risk	The criminal justice system	Offenders	Society-at-large
Uninsured direct costs $1.90	Theft-related insurance premiums $20	Police costs $4.40	Gross benefits (-$1500M) less costs	Additional robberies +
Costs in time off work 20¢	Theft prevention devices $ 5	Court and corrections costs $2.20	to offenders of risks of apprehension, effort and time used	Vehicle accidents +
Opportunity costs of unavailability of vehicle 20¢	Opportunity costs of theft avoidance +			Displacement benefits -
				Benefits to vehicle manufacturers in additional sales ($100M)
Risk costs associated with costs above $2.30				
Total $4.60	**$25**	**$6.60**	**less than $5 (benefits)**	**$1 ? (benefits)**
Implied social costs				
Equity costs · + +	+		+ + +	
Total social costs $4.60 + +	$25 +	$6.60	zero	$1 benefit

*Total 1985 social costs are estimated at just over $4 billion or $35 per automobile in use.

standards. Additional equity costs have been indicated here. As a simple assumption, these costs may be taken to be equal to the net benefits to offenders, so that the social value of net benefits to offenders is treated as zero.

The final row therefore represents the social value that would be placed on the individual costs, taking into account not only their size, but also the justice of their distribution. This has been summed across into a total social cost of auto theft. It is estimated that, in 1985, the cost of auto theft was around $4 billion or $35 per car in use—the equivalent of $45 per car and $6 billion at 1992 prices. These figures are of the same order of magnitude as the unpublished estimate by Brobeck (1983) that the 1981 cost of auto theft was $3.3 billion.

THE COST-EFFECTIVENESS OF AUTO THEFT PREVENTION AND THE INCENTIVES FOR ITS PROVISION

Assessing the Cost-Effectiveness of Prevention Measures

Table 1 also provides a basis for assessing the cost-effectiveness of theft prevention. A socially cost-effective measure of theft prevention will be one that reduces the costs of auto theft to society by more than the cost of the measure.

As an illustrative calculation, let us consider how much it would be worth to invest in built-in vehicle security in order to entirely eliminate auto theft. The average age of cars in use was 7.6 years in 1985 *(Statistical Abstract of the United States,* 1990). It is therefore plausible to suppose that built-in security has a working life of eight years. The value of the built-in security will therefore represent a saving of $45 per year per vehicle at 1992 prices for eight years. Using standard investment appraisal techniques, the net present value of these savings will be $305 at a *5%* discount rate, or $265 at a 10% discount rate[1]. These figures represent order-of-magnitude estimates of the maximum sums that society as a whole might rationally invest in order to entirely eliminate auto theft.

In practice, theft prevention measures will not entirely eliminate auto theft. Under these circumstances, it must not be assumed that a certain percentage reduction in the number of auto thefts will realize proportionate reductions in costs. There are two reasons for this: First the theft prevention measures may prevent only certain types of auto theft, whose costs may be distinctive. Second, some of the costs of auto theft may be subject to economies or diseconomies of scale, so that the average cost per auto theft does not accurately represent the marginal cost—the cost

of one less auto theft. For example, suppose there are certain fixed costs for a police force in dealing with auto thefts—establishing a record system, etc.—and that once this has been done there are few additional costs in dealing with additional auto thefts. In this case the marginal cost to the police of dealing with an additional theft will be less than the average cost. It follows that assessments of the cost-effectiveness of a given means of crime prevention will proceed by comparing the cost of the proposed prevention measure with the resultant marginal savings in the costs of auto theft.

The Incentives to Introduce Theft Prevention Measures

In practice, decisions about whether to introduce theft prevention measures are not made on the basis of an assessment of all the costs involved, because these costs are distributed to different parties. The different parties involved only have incentives to reduce the level of auto theft insofar as this will reduce their own costs. The immediately striking feature about the distribution of auto theft costs illustrated in Table 1 is that a relatively small proportion of the costs of auto theft fall to actual victims. Most of the cost falls to car owners in the form of insurance premiums, and another significant sum to taxpayers through the costs of the criminal justice system.

In the first instance, the decision as to whether or not to purchase a physical means of auto theft prevention falls to the vehicle owners. In making this decision, they will weigh the costs of the prevention measure against the resulting savings to them. Considering the categories of cost in Tkble 1 separately, vehicle owners will certainly consider the savings they will obtain, if, as a result of the improved security of their vehicle, their car is not stolen. At the other end of the scale, vehicle owners have effectively no incentive to take into account the savings to society as a whole, and to the criminal justice system, if their car is not stolen. Although these costs may ultimately fall on individuals in the shape of tax payments, these will be so widely shared that the effect of an individual's car being stolen or not on that same individual's tax bill is effectively nil. The owners also have no incentive to take into account displacement effects—if, as the result of their prevention efforts, their neighbor's car is stolen.

By far the largest category of cost is that which falls to the owners of vehicles at risk, covering the precautionary costs of theft prevention measures and insurance. Individuals may be able to realize some reduction in their own precautionary costs, if they purchase an effective means of theft prevention. They might, for example, feel able to park

their cars in "high risk" areas at times when it is convenient to them, and thereby reduce their opportunity costs. However, the largest precautionary cost, and indeed the largest single component of the costs of auto theft, is the cost of theft-related insurance premiums.

It might be imagined that the installation of effective theft prevention, which will necessarily reduce the risk of auto theft, should yield equivalent reductions in auto-insurance premiums, in the same way as being a non-smoker yields reductions in life insurance premiums. In this way, the individual investor in theft prevention would be able to realize savings in precautionary costs; this will substantially increase the incentive to obtain effective means of theft prevention in the first instance. In practice, the relationship will be much looser, mainly because insurance companies operate in a world of limited information and therefore identify risks in broad categories, rather than precisely identifying the individual risks they are insuring. The loss history of individual automobile models is now published by the Highway Loss Data Institute (HLDI, 1990) and this might be thought to provide a guide to the relative security, and attractiveness for theft, of the different models. However, an insurance company that offered discounts for models with a low loss record could run into difficulties: There is evidence that a good loss record for a particular model may be influenced by the fact that it is owned by people who live in safer areas, or who park off the street—each of which would attract a separate discount in the premium calculation (see Field and Clarke, in press). More fundamentally, given that built-in vehicle security is frequently very limited, variation in theft risk by model is likely to reflect the relative attractions of the different models to thieves rather than variation in security levels (see Clarke and Harris, 1992b). Finally, there is an obvious practical difficulty in tying premium levels to the loss records of a given model: These records will only become available a year or two after the model comes on the market.

The difficulties of justifying a premium discount for add-on vehicle security are even greater. In this case it is likely that persons who purchase such devices are to some extent self-selected as being at high risk of theft, and such risks may well not be captured in the broad geographical and demographic risk categories commonly used by insurance companies. This is the phenomenon known in the insurance market as "adverse selection." This means that even if the additional vehicle security is partially effective, no smaller claims can be expected from those policyholders with theft prevention than from those without such measures. For this reason, the insurance company may not offer a discount for the installed measures. In some states, insurance companies

are legally required to offer discounts in return for the installation of theft prevention measures.

The overall effect of these factors is that variations in vehicle security will be reflected imperfectly, if at all, in variations in insurance premiums. It follows that the individual considering the purchase of theft prevention (either built-in or add-on) for a vehicle has few incentives to take into account the insurance premium costs of auto theft. As noted above, they also have little incentive to take into account the criminal justice costs of auto theft. Individual victim costs—of the order of a few dollars per year—that vehicle owners will take seriously, are very much smaller than the $20 or so in insurance premium costs and around $5 in criminal justice costs.

To illustrate this last point, let us recalculate what it would be worth an individual vehicle owner to invest in auto theft prevention. If the owner is insured against car theft, then the annual expected net losses from car theft will be 40 cents from the uninsured deductible element in any theft losses, 20 cents for time off work, and 20 cents for the opportunity costs of the lack of a vehicle immediately following any theft. This sums to an expected loss of 80 cents per car-year. This loss expectation might be doubled to $1.60 to take into account the costs of risk. Assuming as before that a prevention measure has an eight-year life span, it would be worth an individual owner investing just $10.80 (using a *5%* discount rate) or $9.40 (using a 10% discount rate) to entirely eliminate the risk that his or her car will be stolen. These figures are trivial in comparison with the estimate, made above, that it would be worth as much as $200 or $300 per car, from society's point of view, to invest in physical measures of theft prevention.

In practice, owners will have a somewhat greater incentive than this to protect themselves from car theft, for there will be some uninsurable psychological costs; but it has been argued above that these psychological costs are small. It follows that the incentive for individuals to purchase theft prevention measures is far smaller than that which would be required to promote socially cost-effective theft prevention.

There is one qualification to this result. There is no incentive for individuals to take into account the displacement effects of the prevention measures they adopt; in this respect alone, individuals will be more ready to adopt prevention measures than a notional societal decision maker, assessing all the social costs and benefits of a given prevention initiative. The failure of individual vehicle owners to take into account these displacement costs of prevention may partially compensate for their failure to take into account the shared benefits of prevention. This is a mixed blessing. It is also likely to mean that individuals are biased

towards the purchase of prevention measures that generate so much displacement as to be of no social value. People who have purchased preventive measures have strong incentives to publicize the fact on the vehicle, an approach which means that thieves may well not bother with the protected automobile, but equally, can tackle an unmarked car with less anxiety that they will set off an alarm system. The incentives faced by individual owners mean that a market may well develop, and has developed, for devices that effectively displace crime but do little to reduce its overall level. Therefore, such devices confer little social benefit.

The implementation of theft prevention measures depends not only on consumers being willing to pay for them but also on the willingness of manufacturers to supply them. In the case of add-on security, the issue is not problematic If people are willing to pay for prevention devices an industry will grow up to supply them. Built-in security is a somewhat different issue. If it is considered at all, vehicle security will be no more than a minor consideration in a purchaser's choice of automobile. Manufacturers therefore have considerable discretion over the level of built-in security to provide. Other things being equal, however, it will generally be in the manufacturers' interest to provide the level of built-in security that consumers want and are prepared to pay for. Thus, if a representative consumer prefers to pay an additional $100 for a certain measure of built-in security, the consumer will prefer to buy the model including the security measure than the model lacking it, even though the secure model costs $100 more. If manufacturers introduce a smaller, or greater level of security into their models than is desired by consumers, they will lose customers and therefore profits.

If vehicle manufacturers have no other interests at stake, it follows that the level of security built into vehicles will reflect manufacturers' beliefs about what consumers want and are prepared to pay for. However, manufacturers do have other interests at stake. Some commentators have gone so far as to argue that manufacturers have a profoundly vested interest in auto theft, because it results in additional demand for new vehicles (Brill, 1982; Karmen, 1983). This additional demand has been estimated here as being of the order of several hundred million dollars a year.

This argument neglects the highly competitive nature of the new car market, with a very large number of manufacturers selling models of similar type and price. Those who have their car stolen may have some loyalty to the make and model, but it is also quite probable that they will purchase a quite different make of car. This means that increasing the security of a particular model will only partially reduce the additional

(auto theft-related) demand for that model, for much of that additional demand is attributable to the theft of other makes. Since vehicle manufacturers clearly do not act as a cartel, the incentive falling on any one of them to deliberately reduce the level of design security below that desired by consumers (and suffering lost sales as a result) will be small. A more convincing explanation for the generally low level of built-in security in automobiles is the simplest one—that consumers have little direct incentive to prevent auto theft because few of the costs fall directly to victims.

Policies for Auto Theft Prevention

This paper has estimated the costs of auto theft in 1985 and identified the parties to whom those costs fall. Although these estimates rest on many assumptions, their validity as order-of-magnitude estimates must stand. It has been demonstrated that only a small proportion of the costs of auto theft fall directly to victims. As a result, the potential victims have few incentives to invest in the level of physical auto theft prevention, either built into vehicles or attached to them, that would yield a socially cost-effective level of auto theft prevention. Unless these incentives can be substantially adjusted, there is little prospect of achieving socially worthwhile reductions in auto theft through improved vehicle security.

While this situation remains, manufacturers of cars and security devices for cars will have only a very limited interest in developing, and bringing to the market, vehicle security measures that could be highly cost-effective. Under these conditions, the considerable potential of electronics and information technology to enhance vehicle security will not be fully researched or developed.

The problem under discussion, and its solutions, is a familiar one in economic theory. The problem is one of "externalities," whereby the market decisions of individuals (whether or not to purchase theft prevention) impose additional costs (externalities) on other parties (see, for example, Begg et al., 1984). Since the market decisions fail to reflect the external costs, a socially optimal result is not achieved. Suppose, for example, that production at a local factory pollutes a river. In the absence of any pollution controls, the factory will engage in production up to a level that maximizes factory profits, without taking into account the external costs that river pollution is imposing on society-at-large. A socially optimal solution to the problem would be to permit production by the factory only when the social benefit of the production exceeds the social cost of the pollution caused; the level of production should be

at the point where the marginal social cost of additional production (in terms of pollution) begins to exceed the marginal social benefit of additional production.

Achieving this solution, whereby private decisions effectively take into account the wider social impact of private actions, requires government intervention in the private market. Two commonly discussed approaches are:

- Establishment of standards governing the amount of external social cost that is permitted. An example of this would be vehicle emission standards.
- Taxation of the product or process causing the external social cost (or subsidy if a social benefit is involved). An example of this would be additional taxes on leaded gasoline.

Theft prevention possesses a distinctive feature that effectively determines this choice. In general, individual efforts to prevent auto theft generate external benefits (in terms of insurance premiums and criminal justice costs). They may also generate external costs, if auto theft is displaced from one vehicle to another. Such displacement is particularly likely when prevention measures are introduced partially rather than systematically. Clearly, if theft prevention measures were encouraged by subsidy or tax incentive, or even by manipulation of the insurance market, their introduction would be very partial; it follows that the external benefits of theft prevention would be at least partly counterbalanced by the external costs of crime displacement. Prevention standards have the significant advantage of universality, thereby eliminating the risk of displacement.

Prevention standards also possess another advantage. If theft prevention is built in to vehicles, its universal introduction means that the unit cost of its provision will be reduced by economies of scale.

The immediate introduction of designated security standards in new-model cars is subject to the difficulty that current vehicles have, for the reasons discussed, low levels of security relative to those that would be socially desirable, and the security measures that have been introduced have only rarely been systematically evaluated. The problem is one of the chicken and the egg. In the current automobile market, the incentives on individual car owners to secure their vehicles are so low that manufacturers have little incentive to research and develop more effective security measures: The potential market for prevention measures that would be cost-effective for individual owners is minute in comparison with the size of the potential market for socially cost-effective prevention measures. Nevertheless, the existence of such proven measures is a necessary precursor to the establishment of prevention

standards. This suggests that in the first instance it would be useful not only to establish some basic security standards, but also to give a clear "signal" to the automobile and security industry that new auto theft prevention measures that can be shown to be effective will be implemented in prevention standards. Practically, what is required is the legislative establishment of a theft prevention standard to be required in all new automobiles (and old automobiles on a certain date). A body with responsibility for reviewing and updating the prevention standard would also need to be established, with a clear indication of future dates at which the theft prevention standard will be updated. This should provide the necessary incentive for research and development of effective auto theft prevention.

In Europe, the first steps have been taken toward the establishment of mandatory prevention standards in cars. The U.K. Department of Transport is seeking to have a prevention Standard for cars implemented in the European Community (U.K. Home Office, 1988b). Although such standards would need to be mandatory, the practical cooperation of the vehicle manufacturing industry would be vital to the success of such an initiative. Certainly the industry has few incentives at present to develop built-in theft prevention. However, it can be readily shown that the industry will stand to gain from the implementation of effective standards. First, the industry will gain from the marketing of a new product—built-in vehicle security—that will increase the unit price of the vehicles sold. Second, the intention is that the security will be cost-effective, mainly in respect of insurance costs (criminal justice costs being a less important element). It follows that the overall cost of owning and running a car will fall, since savings in insurance costs will more than compensate for the additional cost of new vehicles. As a result, the number of vehicles sold will increase. The imposition of standards should therefore increase both the unit price of vehicles and the number of units sold, both of which are advantageous to manufacturers. (Emission standards, by contrast, increase unit price, but decrease sales). Manufacturers therefore have strong incentives to cooperate in the establishment of mandatory theft prevention standards.

The arguments advanced here for the establishment of auto theft prevention standards are straightforward in principle, and in economic terms are closely analogous to the economic arguments for vehicle emission standards, for which few would dispute the necessity. Their introduction would nevertheless require an innovation in thinking about the role of the state in preventing crime. That role has normally been seen in terms of the criminal justice system, and perhaps in a partial responsibility for the social conditions that encourage or inhibit crime.

While government might encourage private measures to protect private property from crime, it has normally been accepted that this is essentially a matter for individual discretion unfettered by state intervention. The arguments advanced here turn that role on its head, by asserting that—in the case of auto theft at least—the key contribution of the state lies not in the criminal justice system or even in social conditions, but in the establishment of mandatory standards of privately provided crime prevention.

While this conclusion applies most clearly to auto theft, there is little doubt that it also applies to other types of crime, particularly property crime. In the case of auto theft prevention, a wholesale market failure is attributable to the low victim costs relative to the insurance costs and the criminal justice costs. The same point could almost certainly be made about burglary, although the psychological costs to the burglary victim are larger than in the case of auto theft. Security standards for housing might therefore be justified on similar grounds. In this case the analogy lies with fire prevention standards in housing, where the justification also lies (at least partly) in an external benefit of fire prevention (less risk to neighboring dwellings). Even in the case of uninsured property losses, such as from shoplifting, a market failure arises from the criminal justice costs of shoplifting that retailers have no incentive to consider. One option in this case might be to "charge" large retailers for the criminal justice processing of each person convicted of shoplifting in their stores—although it might be objected, on distributional grounds, that this would increase the disincentive for retailers to locate in poor, high-risk urban areas (see Pease, 1979).

In practice, decisions about how and whether to regulate imperfect markets will have to take into account the specific crime concerned and the real costs that any regulatory framework creates not only for government, but also to those subject to regulation. That said, the theoretical arguments here are clear. The private market in crime prevention is a highly imperfect market, in that demand for such prevention is determined without regard to the large external benefits of such prevention. A substantial amount of research evidence suggests that crime prevention, in the shape of simple physical measures to prevent crime, can be effective in reducing the level of crime (Clarke, 1992). If those potential gains are to be realized, a willingness for government to take on a new criminal justice role—as a regulator of imperfect private markets—will be necessary.

✦

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NOTES

1. This utilizes the standard formula used to estimate the "net present value" of a future income stream:

$$\text{net present value} = X + X^{(1-r)} + X^{(1-r)^2} \quad \dots\dots + X^{(1-r)^{(T-1)}}$$

X = annual income

T = number of years over which income stream is expected

r = annual interest rate expressed as a ratio.

All values in real (after inflation) terms.

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