The American Journal of ECONOMICS and SOCIOLOGY
April, 1995

Burglar and fire alarms

Costs and Benefits to the Locality

By **Simon Hakim, George F. Rengert *and* Yochanan Shachmurov**

Abstract: The alarm industry has been estimated at 8-11 billion dollars in 1993. There are approximately 17 million alarms installed nationwide. The annual growth of installations has been 8 percent over the last five years. At the same time, the number of false activations per system is 1.1 to 1.4 per year, with 20 to 30 percent of police manpower devoted to false activations. 94-98 percent of all activations are false. Indeed, false activations pose a severe problem for local police departments which respond with stiff fines for false activations and reduced response to alarm activations in general which are not high risk such as jewelry stores, banks or government facilities. This paper identifies the social benefits and costs which result from burglar and fire alarms in a given community. Included benefits are reduced burglary, assault, and rape incidents as well as fewer incidents of fire which are detected early and controlled. Costs include police response to alarms, costs of installation and monthly monitoring fees. The results demonstrate that, indeed, burglar and fire alarms provide a net social benefit to the locality. The paper suggests that charges for false alarms should be allocated directly to the police which service them. Such users' fee method will improve resource allocation, and prevent a situation where alarms become useless.

I

Introduction

Fire and crime which occur in homes are costly and demoralizing events that affect every residential community. Victims suffer financial loss, days lost from work, and a dramatic decrease in the quality of life when their privacy is invaded and their homes are no longer regarded as safe havens. All citizens are affected by higher insurance premiums and higher taxes to pay for stepped-up police and fire protection. Neighbors of fire and crime victims also experience a decrease in their quality of life associated with the alienation and despair that accompanies the fear of crime and the apprehension of fire in a community (Krohm, 1973; Sesnowitz, 1972, 1973; Brantingham and Brantingham, 1975; and Jarrell and Howsen, 1990). Sometimes crime and fire are directly associated as in the case of arson. In other cases, invasive crime can take many forms independent of arson. In any event, criminals cause everyone to pay for their criminal acts, either directly or indirectly.

Consider the case of residential burglary. Alarms may change burglaries into attempted burglaries which although still a crime, do not make the victims suffer as great a loss since the actual crime of burglary is prevented. The National Crime Prevention Institute (1986) operationally defines crime prevention as the practice of crime risk management. "Crime risk management involves the

development of systematic approaches to crime risk reduction that are cost effective and that promote both the security and the socioeconomic well-being of the potential victim" (2). Note that this definition includes both social and economic costs of crime.

In the case of residential alarms, the key phrase in this operational definition is "cost effective." It can be argued that residential alarms would not be cost effective if the owners were required to pay the true costs of servicing these alarms by the police and fire departments, including the false activations. Much of the costs of servicing residential alarms is paid for by the general public who support the police and fire departments from their general tax base. Furthermore, not all the residents of a community can afford or choose to install residential alarms. If the costs paid by those residents who do not own alarms were to accrue to the alarm owners, the question of whether residential alarms are cost effective would be answered directly. But these costs are borne by the entire community, owners and non-owners of alarms. Non-alarm owning residents experience few of the benefits, although they share in the costs of servicing the alarms. This article assesses whether or not the community as a whole benefits from the existence of the alarms.

In the case of residential burglary, there is the added question of whether alarms increase or decrease the burglary rate in other non-alarmed houses. This is referred to as the spatial displacement of crime (Meithe, 1991). There are, at least two possibilities: First, the burglar skips the protected house and goes to the unprotected, as a result, total burglary rate remains the same or diminishes somewhat perhaps because of the time factor. Thus, the victims have merely changed. The second possibility is that burglars cannot tell which houses are protected (unprotected houses may have fake alarm notices, for example) but do know, by experience, what fraction of houses in the neighborhood are protected. This experience is referred to as "learning by doing" (Deutsch, Hakim and Spiegel, 1990). If burglars have a feel for what percentage of houses in a community have alarms, then the alarms serve two functions. One is to stop a burglary in progress (only for alarm-protected houses in communities in which burglars feel the proportion of alarmed houses is low enough to exploit). The second is to deter attempts (in communities in which burglars feel the proportion of alarmed properties is too high to exploit), and this works equally well for protected and unprotected houses.

The act of installing an alarm is linked to a field in criminal justice called "designing out crime," or "problem solving policing" (Clarke, 1983, 1992; Poyner, 1983, 1993; Sesnowitz, 1988; Brantingham and Brantingham, 1990; and Felson, 1993). This approach seeks to prevent crime from occurring in the first place, rather than waiting for it to happen, and then trying to arrest somebody. Thus those who wish to design out crime strongly believe that the criminal justice system is a backup rather than the centerpiece of crime prevention. In addition, the adherents have collected information indicating that many types of situational and micro-environmental crime prevention, such as burglar alarms, do not serve merely to displace crime to new settings, but rather reduce overall crime levels, (Miethe, 1991; Poyner, 1993). These authors argue that the overall costs of crime are reduced by burglar alarms.

A correlation exists between having a burglar or fire alarm and the other characteristics of the house. For example, evidence suggests that alarms are perceived as luxury goods. The more expensive homes are, the higher the probability that they are protected by alarms. Since more expansive homes include more valuable contents, they are more likely to be protected by alarms. This suggests that benefits from alarms may be larger than estimated since the alarms are not merely deterring random burglaries and detecting random fires but are of particular value to the expensive homes' owners. This applies to both houses with valuable property and houses with

vulnerable inhabitants, (Nasar, 1981; Rengert, 1988; and Sesnowitz and Hexter, 1982). In the analysis that follows, a conservative estimate is used by assuming that burglar and fire alarms are installed in the average, rather than the more affluent homes in the same township.

A point of special concern is the rate of false activations. Residents without alarms would not resent valid activations since these might remove a burglar from the community or prevent a fire from spreading. However, the traditional criminal justice literature assumes that no one benefits from a false activation, and most residential alarm activations are false alarms (Hakim and Buck, 1992). Not only are non-alarm homeowners affected by these false alarm activations, the local police, fire and township officials also are concerned. Police soon lose a sense of urgency and precaution when responding because of false alarms. This is dangerous to the officers who might encounter an actual criminal while they are unprepared. In many localities, the responding officer approaches the property with citation book, rather than being prepared to encounter a burglar.

False alarms incur cost, but no benefit save the benefit to the home owner of not having to pay for a more reliable system or take the trouble to use it more carefully. So the home owner should be charged for the false alarms. It is actually a private service he obtained rather than a public good which everyone enjoys. However, as noted above, alarms also remove burglars from the community and from society at large, (Poyner, 1993). Fires are detected early which keeps them from spreading to adjoining properties. Thus, the incentive not to have an alarm system - for fear of having to pay for its occasional false activation - is an inefficient one. People will have fewer alarms than would be desirable, because they do not internalize the positive externalities to the society.

II

Socioeconomic Characteristics of the Locality

This study focuses on Tredyffrin Township in Chester County, Pennsylvania. Tredyffrin Township is a distant suburb of Philadelphia located nearly twenty miles west of the city. It is predominately white with a relatively young median age of 32.8 years (three to five years younger than the older suburbs closer to Philadelphia). The median home value and average sale price are over thirty thousand dollars greater than neighboring suburban townships closer to Philadelphia. It has relatively few retail establishments but does contain several large office buildings and manufacturing firms. It still contains vacant land and farms interspersed with the housing developments. It has 47 police officers, more per capita, but fewer per square mile, than neighboring suburbs closer to Philadelphia.

The data collected were based on individual homes. They included police files on the attributes of burglaries (including the value of property stolen) and alarm ownership. Also, a questionnaire was mailed to residents of the community to obtain information on both burglarized and non-burglarized homes in the township. The questionnaires were mailed with a letter signed by the police chief to all residential units which had reported to the police in the two and a half years prior to the study that they had been burglarized. It also was sent to a random sample of alarm owners, and, based on police records to a matched control group of adjacent homes which were neither burglarized nor own alarms. The returned questionnaires determined that police records were accurate in identifying alarmed and unalarmed residential units. Adjacent residential units were used to control for variation in the value of the units and environmental conditions surrounding them. Forty two percent of the questionnaires which were mailed out were completed and returned.

Tredyffrin Township is a prototype east coast affluent suburban community. It is plausible to assume that similar results will be obtained for other Northeast U.S. suburban localities. The analysis which follows is conducted conservatively; in case of uncertainty, costs are over-estimated and benefits are under-estimated.

III

False Alarm Activations

Most of the alarm activations responded by the Tredyffrin Police Department were false caused either by residents errors, natural factors such as wind and thunderstorms, or by malfunctioning systems. False activations generate friction between alarm owners, police departments, and local township officials. The high rate of false activations calculated from the Hakim and Buck Study (1991, Table 5.1, 126) is estimated at 1.2 per system a year, with an annual growth of eight percent a year. Clearly false activations of burglar alarms is a serious problem for Tredyffrin Township, as it is for all big American cities and suburban localities.

Based on national data, Shanahan (1992) estimates that between ten and thirty percent of calls to the police are due to false alarms. Nationwide ownership of alarms is estimated at seventeen million systems, or eleven percent of the structural units. This figure indicates the severity of the false alarm problem. Approximately one forth of the Tredyffrin police department's resources are consumed by false alarm responses. Frequent response to false activations has produced resentment among police officers against alarm owners due to the latters' careless use of the systems. There is also police resentment against alarm companies for improper installation of systems and inadequate training of their owners. The police feel that it is necessary to impose fines to make alarm users and alarm companies reduce false activations. The fines also are used to encourage manufacturers and installers to improve managerial and hardware components of alarms to reduce false activations.

IV

Costs and Benefits to the Locality

This article tests whether alarms provide net benefits to the community, and to police departments given the existing levels of false activations. Even if alarms do produce net benefits to localities, this would not preclude current efforts to control and reduce false activations. However, the analysis is potentially beneficial to alarm associations and installers who must react to local ordinances which impose restraints on residents who own alarms. Identifying the benefits and costs to local communities will provide a comprehensive understanding of the net effects of alarm systems. It will redirect the attention of local policy makers from the mere cost considerations of false activations to a more balanced perspective which considers the benefits and the costs segments of the community and to its entirety.

V

Measurements of Cost

The first cost to be considered is installation outlays. The average cost of a system in Tredyffrin Township has been calculated (Hakim and Buck, 1991,78) to be $2244. There were 1818 alarm owners in the township. The life span of a system is estimated to be fifteen years and the capital

recovery rate at six percent (see Appendix). Thus, the annual cost to all alarm owners in Tredyffrin Township is:

cost of one unit x number of alarm owners x capital recovery rate

= $2,244 x 1,818 X 0.10296 = $420,035 [1]

Next, the monthly service charges are considered. The average service charge has been determined to be $26 per month. Eighty percent of all alarm owners in the Township are connected to a central station. Thus, the annual cost of the service charges is:

monthly charge x months x percent of owners paying the charge

x number of alarm owners = $26 x 12 x 0.8 x 1,818 = $453,773 [2]

Now, we come to the costs accrued to the police department through response to false activations. The police budget for 1990 was $2,849,626. Operating costs include wages of officers, maintenance of facilities and cruisers, fees to the county dispatching service, replacement of equipment, cost of support personnel, heat and electricity. The number of officers in the department totaled 47. We assume that seven officers and the eight civilians are part of the overhead costs, leaving 40 officers available for direct crime prevention. In addition, we assume that the officers actually work at their basic job only 230 working days, or 1,840 annually. This calculation allows for days off, vacation and sick time, holidays, and in-service training. These figures are the experience of the Tredyffrin Township police department. Thus, the cost per hour per officer is:

yearly police budget of $2,849,626 divided by (40 officers

x 230 days x 8 hours = $38.71. [3]

Since the total operating budget is used to calculate the cost per person per hour, this figure represents the fully loaded cost of one hour of an officer's time. In other words, there are no other costs that were not considered. Two officers respond to each activation with two cars, and the average response time is 9/10 hours. This is the avenge time needed to clear an alarm activation from initial call, to response, and to subsequent follow-up. Since an ordinance was enacted to fine owners for false activations, the number of activations were significantly down from previous years. The police in Tredyffrin Township have stated that the officers on regular patrol are diverted from public service and routine patrol to respond to alarm activations. In other words, there is an opportunity cost of responding to alarm activations since the officers who answer these calls are not available to conduct other security and service chores. A conservative estimate of this opportunity cost is the average cost of the two officers' time since it is assumed that the actual cost would have diminished at their average cost. Clearly, the real cost of responding to alarm activations to the community is lower than the average cost we used. Therefore, the cost imposed on the police department for each activation is calculated as:

cost per hour * number of officers * average response time

= $38.71 x 2 x 9/10 = $69.68. [4]

There were 1996 activations in Tredyffrin Township in 1990 which yields total cost of response for both manpower and automobiles to be $139,081. This figure includes response to both burglar and fire alarms. That figure indicates that the alternative benefits accruing to the community from other denied patrol activities when the officers respond to alarms are equal to the real cost.

The total cost to Tredyffrin Township of residential alarms is the sum of installation costs, monthly service costs, and the costs of responding to false activations. These figures total to $1,012,889 per year. This is a significant cost to the alarm owners and to other members of the community. The issue now turns to whether or not the benefits of alarms outweigh these significant costs.

V

Measures of Benefits

The first obvious benefit to alarm owners is avoided burglaries. A nonmonetary cost, which does not occur when residential break-ins are avoided, is personal injury and emotional discomfort to the victimized residents. At the national scale, in thirteen percent of all break-ins, burglars encountered someone in the home. In almost one third of these cases, the confrontation ended in assault, of which ten percent were rape (Dingle, 1991, 96-97; Bureau of Justice statistics, 1985; Rand, 1991).

Cohen (1988, A and B) has provided data on the cost of crime to victims based upon national statistics and jury awards in personal injury accident cases. The probability that a property protected by an alarm becomes a victim of burglary is the ratio of the number of properties which are burgled and alarmed, to the number of alarmed properties in the community, and is calculated to be 0.0104. The probability that a property that is unprotected by an alarm becomes a victim of burglary is the ratio of the number of burgled properties which do not have an alarm, to the total number of properties which do not have an alarm in the community, and is calculated to be 0.0306. Using these figures, we calculated the avoided violent crime as: the difference in probability of residential break-ins without, and with an alarm, multiplied by the number of homes with alarms. Then, this figure was multiplied by the average cost of crime as estimated by Cohen (1988: Table 1).

The Cost of Assaults is then the average cost of an assault x (probability of burglary without an alarm - probability of burglary with an alarm) x number of alarm owners x proportion of homes that were occupied x proportion of homes that were occupied x proportion of occupied homes that ended in assault. This yields,

$12,028 x (.0306 - .0104) x 1,818 x .13 x 333 = $19,122 [5]

The Cost of Assaults that Includes Rape is the average cost of rape x (probability of burglary without an alarm - probability of burglary with an alarm) x number of alarm owners x proportion of houses occupied x proportion of occupied homes that ended in assault x proportion of assaults that ended in rape. This is calculated as

$51,058 x (.0306 - .0104) x 1,818 x .13 x .333 x .1 = $8,117 [6]

The direct monetary losses of burglary to a victimized household, which include the costs of repairs, lost wages from time off work, excluding the value of the goods stolen, were estimated by Cohen (1988) at $939.

The nonmonetary costs of burglary include the pain and suffering which is estimated by Cohen (1988) at $317 and risk of death which is estimated at $116. The average total nonmonetary costs of burglary are $433.

The monetary costs of burglary of $939 plus the nonmonetary costs of burglary of $433 yields an average total cost of burglary of $1,372 (Cohen, 1988)

The Total Cost of Burglary to the Community Excluding Stolen Property is determined as the average total costs of burglary excluding stolen property x (probability of burglary without an alarm - probability of burglary with an alarm) x number of alarm owners. Thus,

$1,372 x (.0306 - .0104) x 1,818 = $50,385 [7]

To summarize, the total avoided costs, excluding stolen property in the township due to existing alarms total $50,385. The avoided cost of the similar three categories for assaults is $19,122, and of avoided rapes is $8,117. Thus, without considering the value of the stolen property, alarmed homes in Tredyffrin Township avoided violent crime, nonmonetary and monetary costs estimated to have a total benefit of $77,624.

Next, the direct costs of property stolen that are avoided by alarm owners are considered in Table 1. The first column assumes that there are no alarms in the community. Based on the survey, the burglary rate to all housing units without alarms yields an expected 319 burglaries which would have resulted in the Township in 1990 if no alarms existed. On avenge, unalarmed residences in Tredyffrin Township lose $1,674. per incident, giving a total loss of $534,006. If there are alarms in the community, 1,818 homes suffer a successful attack rate of 0.0104, yielding an expected number of burgled, alarmed properties of 19. Now, adding the burglaries expected to occur in the remainder of the population yields 236 incidents. Now, by applying the average loss to each of these to obtain the expected losses of $24,106 in alarmed properties, and $440,888 in non-alarmed residences are determined. The difference between these two states of the world, alarms versus no alarms follows from

(2) + (3) - (1) = 24,106 + 440,888 - 534,006 [8]

This yields a reduction in losses of $69,012 because burglar alarms exist in Tredyffrin Township.

But more must be said. Since not all burglary attempts in Tredyffrin Township were successful the case of incomplete burglaries must be considered. About two percent of the alarmed properties were attacked unsuccessfully. The burglar is presumed to have been scared off by the alarm's activation. This means that 36 (.02 x 1,818) properties suffered no loss. Each would have lost $1,674 had they not had an alarm. This results in an additional total loss avoided of $60,264.

A further well recognized cost of successful burglaries is demoralization costs. These are emotional costs associated with the trauma of the invasion of privacy, vulnerability feeling, and loss of items of sentimental value. These losses have no market monetary value and are not recoverable via insurance. About ninety percent of burglarized homes in Tredyffrin Township reacted to burglary by installing alarms. Interestingly, the survey shows that households which

were burglarized did not turn to other security precautions, (such as putting on neighborhood guards, installing steel shutters, better locks, walls with broken glass, dogs), other than alarm systems.

Table 1

Table 2

Poyner, B. 1993. "What Works in Crime Prevention: An Overview of Evaluations." Crime Prevention Studies 1:7-34.

Rand, Michael. 1991. Crime and the Nation's Households, 1990. Washington, DC: Bureau of Justice Statistics Bulletin.

Rengert, G. 1988. "The Location of Facilities and Crime." Journal of Security Administration 11 2:12-16.

Ross, A. Stephen, Randolph W. Westerfield and Jeffrey F. Jaffe. 1993. Corporate Finance. 3rd. ed. Homewood, IL: Irwin Series in Finance.

Sesnowitz, Michael, L. 1972. "The Returns to Burglary." Western Economic Journal 10 4:477-81.

Sesnowitz, Michael, L. 1973. "The Returns to Burglary: An Alternative to the Alternative." Western Economic Journal 11 3:368-70.

Sesnowitz, Michael, L. 1988. "The Returns to Burglary" in Alper Neil O. and Daryl A. Hellman, eds. Economics of Crime: A Reader. Needham Heights, MA: Simon and Schuster, Ginn Press, 143-49.

Sesnowitz, Michael L. and Lawrence, J. Hexter. 1982. "Economic Determinants of Theft: Some Empirical Results." Public Finance Quarterly 10 4:482-98.

Shanahan, Michael G. 1992. "False Alarms: A Real Danger." The New York Times Sat. Mar. 14, (Op-Ed Page).

Varian, Hal R. 1993. Intermediate Microeconomics A Modern Approach. 3rd ed. New York and London: W. W. Norton.

Appendix

Calculating the Capital Recovery Rate for 6 Percent for 15 Years

Consider an investment project where all of the project costs occur in the current year, the net present value of the project equals [Sigma][[X.sub.t]/(1 + r)] - C, where [Sigma] is indexed by i from one to the last period of the project, say, n, and where,

[X.sub.t] denotes the cash flow in year t,

C denotes the investment outlay,

and r equals the interest rate.

If a project's net present value is greater than zero, it should be accepted, if not it should be rejected (Ross, Westerfield and Jaffe (1993), pages 51-243, especially pages 96-99; Kohler (1992), pages 405-428, especially pages 413-414 and 421; Varian (1993), pages 188-198). In our case, let's consider an outlay today of one dollar and [X.sub.t] = X where X is a constant for all the n periods set to fifteen years. Then, applying the formula we have:

1 = X/1.06 + X/[(1.06).sup.2] + . . . + x/[(1.06).sup.15]. [1]

For simplicity, define q as equal to:

q = 1/1.06. [2]

Using equation [2], equation [1] becomes:

1 = Xq + X[q.sup.2] + . . . + X[q.sup.15].

= x(q + [q.sup.2] + . . . + [q.sup.15]) [3]

Now, multiply both sides of equation [3] by q to yield:

q = X[q.sup.2] + X[q.sup.3] + . . . + X[q.sup.16].

= x([q.sup.2] + [q.sup.3] + . . . + [q.sup.16]) [4]

Next, subtract equation [4] from equation [3] to give:

1 - q = x(q - [q.sup.16]). [5]

Finally, we can extract the value of X, to yield:

X = (1 - q)/(q - [q.sup.16]). [6]

Using the value for q in our case:

q = 1/(1 + r) = 1/1.06 = 0.94339, [7]

equation [6] is equal to:

X = (1 - 0.94339)/(0.94339 - 0.3936) = 0.10296. [8]

This capital recovery rate is used throughout the paper.

[Simon Hakim, PhD., is professor of economics, and George F. Rengert, PhD., is professor of criminal justice at Temple University, Philadelphia, PA 19122. Yochanan Shachmurove, PhD., (of Bar-Ilan University, Ramat-Gan, Israel 59200) is visiting professor of economics at the University of Pennsylvania, 3718 Locust Walk, Philadelphia, PA 19104-6297.] All correspondence should be addressed to Professor Shachmurove.

COPYRIGHT 1995 American Journal of Economics and Sociology, Inc.
COPYRIGHT 2004 Gale Group