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Invited article

Costs and benefits of alarms to the community:
burglary patterns and security measures in
Tredyffrin township, Pennsylvania[☆]

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Abstract

This article is aimed at testing whether alarms provide net benefits to the community, including police departments, given the existing levels of false activations. Obviously, even if alarms do produce net benefits to the locality, it does not preclude current efforts to control and decrease false activations. This analysis will be beneficial to alarm associations and installers who attempt to prevent or alter local ordinances which impose restraints on businesses and residents who own alarms. Revealing the benefits and costs to local communities and to the police provides a comprehensive understanding of the net effects of alarm systems. It redirects the attention of local policy makers from the mere cost considerations of false activations to the overall costs and benefits effects. Tredyffrin township in Pennsylvania is a prototype east coast affluent suburban locality. It is plausible to assume that similar results will be obtained for other suburban localities, although at different magnitudes. The analysis is conducted conservatively; in case of uncertainty, costs are overestimated and benefits are underestimated or even assumed away. The effects on the community are often termed social or real costs and benefits [1]. These effects can accrue to alarm users and nonusers, installers, police and fire departments and insurers. We begin with the cost variables, first for the residential units and then for the commercial structures.

Keywords: Alarms; Costs and benefits; Analysis

1. Cost variables

1.1. Residential costs variables

The first cost to be considered is residential installation outlays. The average cost of a residential system in Tredyffrin Township has been calculated by Hakim and Buck (1991, p. 78) to be \$2244. There were 1818 residential alarm owners in the township.

We estimate the life span of a system to be fifteen years and the capital recovery rate at six percent. Thus, the annual cost to all residential alarm owners in Tredyffrin Township is:

cost of one unit: \$2244.00
● residential units: 1818
● capital recovery rate: 0.10296

= \$420 035.

[☆]This article is a slightly revised chapter from 'Commercial Security: Burglary Patterns and Security Measures,' by Simon Hakim and Mary Ann Gaffney. To obtain a complete copy, contact: Security Industry Association, 635 Slaters Lane, Ste. 110, Alexandria, VA 22314.

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Next, we consider the monthly service charges. The average service charge has been determined to be \$26.00 per month. Eighty percent of all residential alarm owners in the Township are connected to a

central station. Thus, the annual cost of the service charges is:

- monthly charge: \$26
- months: 12
- residential owners paying the charge: 0.8
- residential alarm owners: 1818

= \$453 773.

Now we come to the costs accrued to the police department through response to residential false activations. The police budget for 1990 was \$2 849 626. Operating costs include officers' wages, maintenance of facilities and cruisers, fees to the dispatching service, equipment replacement, cost of support personnel, heat and electricity. The number of officers in the department totalled 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 annually. This calculation allows for days off, vacation and sick time, holidays, and in-service training. Thus, the cost per hour per officer is:

- yearly police budget: \$2 849 626
- divided by: (40 officers × 230 days × 8 h)

= \$38.71.

Since we have used the total operating budget to calculate the cost per man per hour, this figure represents the fully loaded cost of one hour of an officer's time. Two officers respond to each activation with two cars, and the average response time is nine tenths of an hour. This is the average time needed to clear an alarm activation from initial call to response and 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. However, in the absence of alarm response, manpower would not have diminished. In order to be conservative on the cost, we assumed that actual cost would have diminished at their average cost. Clearly, the real cost of responding to alarm activations in the community is lower than the average cost we used. Therefore, the cost imposed on the police department for each activation is calculated as:

\$38.71 per hour

- 2 officers

- 9/10 h

= \$69.68.

There were 1996 residential false activations in Tredyffrin Township in 1990 which yield total cost of response for both manpower and automobiles of \$139 081. This figure includes response for both residential burglary and fire. 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 residential installation costs, monthly service costs, and the costs of responding to false activations. These figures total to \$1 012 889 per year.

1.2. Commercial cost variables

The average cost of an installed alarm in a commercial unit in the township has been calculated by Hakim and Buck (1991, p. 78) to be \$3200. There were 440 commercial alarm owners in the township. As illustrated in the residential part, it is estimated that the life span of a system is fifteen years and the capital recovery rate is assumed at six percent. In addition, alarms are considered part of business expenses and are depreciated faster for tax consideration. Continuing with our conservative estimate, we assume that the tax code assumes a fifteen year life span, and as a result we apply the corporate tax rate of 34% yearly. The tax benefit means that the firm is really paying only (1 — the corporate tax rate) 66% of the cost of installing the alarm. The fact that the tax code allows faster depreciation means that the benefit to commercial units are higher than we estimate. Taking all the above into consideration it can be estimated that the annual cost to all commercial alarm owners in Tredyffrin township is:

Cost of one unit: \$3200

- commercial alarm units: 440
- capital recovery rate: 0.10296
- after tax cost: 0.66

= \$95 679.

The average monthly service charge has been found to be \$100.00 per month (Hakim, 1991). Only 74% of all commercial alarm owners in the Township are connected to a central station. This low figure reflects the fact that many retailers are not connected to a central station. All the monthly charges are recognized as business expenses. Thus, the annual cost of

the service charges is:

Monthly charge of \$100.00

- Months: 12
- Owners paying charges: 0.74
- Commercial alarm owners: 440
- After tax cost: 0.66

= \$257 875.

The costs imposed on the police department through response to false activations was calculated earlier to be \$69.68. In 1990, there were 528 commercial false activations in the Tredyffrin township which yields a total response cost for both manpower and automobiles of \$36 152. This figure includes response for both burglary and fire.

The total cost of commercial alarms to the Tredyffrin township is the sum of commercial installation costs, monthly service costs, and the costs of responding to false activations. These figures total to \$390 345 per year. The total residential and commercial costs are thus estimated to be \$1 403 230. 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 costs.

2. Benefit variables

2.1. Residential benefit variables

The first obvious benefit to the alarm owners is avoided burglaries. Avoided non-monetary costs of burglary include personal injuries and emotional discomforts to the victimized persons. On the national level, in 13% of all break-ins, burglars encountered someone in the home; in almost one third of these cases, the confrontation ended in assault, 10% of which were rape [2]. Cohen [3] has calculated the cost of crime to victims based upon national statistics and

jury awards in personal injury accident cases. Using these figures, we calculated the avoided violent crime as the difference in probability of burglary with and without an alarm multiplied by the number of homes with alarms. Then, this figure was multiplied by the cost of average crime as estimated by Cohen (1988: Table 1). For the total cost of assaults, we multiplied: the average cost of assault of \$12 028

- probability of burglary without an alarm: 0.0306
- probability of burglary with an alarm: 0.0104
- alarm owners: 1818
- proportion of homes where somebody was present at the time of the break-in: 0.13
- proportion of occupied homes that ended in assault: 0.333

= \$19 122.

The average cost of rape is: \$51 058

- probability of burglary without an alarm: 0.0306
- probability of burglary with an alarm: 0.0104
- alarm owners: 1818
- proportion of houses occupied: 0.13
- proportion of occupied homes that ended in assault: 0.333
- proportion of assaults that ended in rape: 0.10

= \$8 117.

The direct monetary losses of burglary to a victimized homeowner, which include the costs of repairs, lost wages from time off work excluding the value of the goods stolen, were estimated at \$939, pain and suffering at \$317, risk of death at \$116, reaching an average cost of burglary of \$1372. Therefore, the calculation of the nonmonetary costs of burglary is:

Non-monetary costs of burglary: \$1372

- probability of burglary without an alarm: 0.0306

Table 1
Direct costs and benefits of residential alarms in the community

	No. alarms in the community (1)	Equipped (2)	Unequipped (3)
Housing units	10 425	1818	8607
× Burglary rate	0.0306	0.0104	0.0306
Expected number of burglaries	319	19	263
× Loss per burglary	\$ 1674	\$ 1275	\$ 1674
Total expected loss	\$534 014	\$24 106	\$440 888

- probability of burglary with an alarm: 0.0104
 - alarm owners: 1818
- = \$50385.

To summarize, the avoided costs by existing alarms of pain, suffering, and risk of death in residential units add to \$50385. The avoided cost of the same three categories for assaults is \$19122, and of avoided rapes is \$8117. Thus, alarmed homes in Tredyffrin township avoided violent crime for non-monetary benefits of burglary is \$77624.

Next, we consider the direct costs of residential property stolen that are avoided by alarm owners. Our computations are illustrated in Table 1. The first column assumes that there are no residential alarms in the community. Applying the historical 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 average, unalarmed residences lose \$1674 per incident, yielding a total loss of \$534006. If there are alarms in the community, 1818 homes suffer a successful attack rate of 0.0104, giving us an expected number of burgled, alarmed properties of 19. To these add those expected to occur in the remainder of the population, 236 incidents. Now, applying the average loss to each yields expected losses of \$24106 in alarmed and \$440888 in non-alarmed residences. The difference between these two states of the world, alarms versus no alarms ((2) + (3) - (1) = 24106 + 440888 - 534006), is a reduction in losses of \$69012 due to the existence of burglar alarms in the Tredyffrin township.

Not all burglary attempts in Tredyffrin township were successful. We must also consider the case of incomplete burglary. Two percent of alarmed properties experience unsuccessful burglary attempts. Burglars are presumed to be scared off by the alarm's activation. This means that $0.02 \times 1818 = 36$ properties suffered no loss. They would have lost \$1674 had they not had an alarm. Thus, total loss avoided is \$60264.

A further well recognized cost of successful burglaries is demoralization. These are emotional costs associated with the trauma of the invasion of privacy, feeling of vulnerability, and loss of items with sentimental value. In this affluent community all residences are insured. The insurance protects against the monetary loss of assets. Alarm installation protects against future burglaries and its resulting demoralization costs. Ninety percent of the burgled population in the township installed alarms after burglary. Therefore, paying for alarms today saves the homeowners from both buying an alarm in the future

and from being burglarized in the future. Accordingly, the annualized cost of alarm installation and the monthly charges may be conservative estimates of the non-monetary costs which are not recovered from insurers. The annualized demoralization costs associated with burglaries avoided by alarm owners are:
Installation costs:

Homes installing alarms after burglary: 0.9

- unit cost: \$2244
- capital recovery rate: 0.10296
- number of alarmed homes expected not to be burglarized: 1799

= \$374080.

Monthly charges:

Homes installing alarms after burglary: 0.9

- Monthly charges: \$26
- Months: 12
- capital recovery rate: 0.10296
- alarmed homes expected not to be burgled: 1799

= \$52011.

Thus, total demoralization costs are (\$374080 + \$52011) \$426091.

Additionally, most systems protect against both fire and burglaries. Therefore, one other benefit to the township is the avoidance of fire. Indeed, fire protection alarms do not get the attention they deserve. About 2.5% of the homes in the sample claimed that their alarm systems detected fires (Hakim and Buck, 1991, p. 106). Using our survey responses, we find that 19% of expected fires are eliminated due to the use of alarms. The fires at alarm equipped residential properties had minimal damages due to early detection. Thus, we conservatively assume that alarms prevent fires in one percent of all households. Further, we may assume that it includes the upper 50-th percentile in the seriousness of fires. If those homes had not had an alarm system, an additional 49 homes in Tredyffrin Township would have had a serious fire. Using national figures, [4] average loss due to fire in the United States is \$7286. This is a very conservative measure for a high income suburb like the Tredyffrin township. Using these figures, avoided residential losses due to fire total annually to \$357014.

Demoralization costs also accrue from fire loss. Again, as in the case of burglary, these costs pertain to devastation associated with destruction of a home and loss of personal items with sentimental value. Estimating these losses is very difficult, so we chose to

maintain our conservative estimate of benefits and provide no monetary value to these benefits.

Finally, we consider the insurance discounts on policy premiums for alarm owners. The nature of the discount and its level vary significantly among companies. Using a conservative estimate of \$500 annual premium and a ten percent discount yields an additional benefit of $\$50 \times 1818$ alarmed units = \$90 900.

The total benefits of alarm ownership to Tredyffrin Township sum to \$1 080 905. These are conservative estimates of avoided losses due to the existence of alarms in the township.

2.2. Commercial benefit variables

Maintaining conservative estimates we assume that the probability of rape in commercial structures resulting from burglary is zero. The benefits of prevented burglaries consist only of avoidance of assault and the indirect non-monetary benefits. The probability of burglary without an alarm is 0.15480 and with an alarm is 0.04776. Following the residential calculation, the total cost of assaults is estimated as:

The average cost of assault: \$12 028

- (probability of burglary in commercial units without alarms, 0.15480 - probability of burglary in commercial units with alarms, 0.04776)
- commercial alarm owners: 440
- proportion of commercial units somebody was present at the time of the break-in: 0.13
- proportion of occupied structures ending in assault: 0.333

= \$24 523.

The total cost of rape is assumed to be null. The direct non-monetary losses of burglary to a business owner, which include the costs of repairs, lost wages from time off work, excluding the value of the goods stolen, were estimated at \$939, pain and suffering at \$317, risk of death at \$116. The average cost of

burglary is \$1372. Therefore, the calculation of the non-monetary costs of burglary is:

Non-monetary costs of burglary: \$1372

- probability of burglary without an alarm: 0.15480
- probability of burglary with an alarm: 0.04776
- commercial alarm owners: 440

= \$64 618.

To summarize, the avoided costs by existing alarms of pain, suffering, and risk of death in commercial units is \$89 141.

Next, we consider the direct costs avoided by alarm owners of commercial property stolen. Our computations are illustrated in Table 2. The first column assumes that there are no commercial alarms in the community. Applying the historical burglary rate to all commercial units without alarms yields an expected 120 burglaries which would have resulted in the township in 1990 if no alarms existed. On average, unalarmed commercial units lose \$1817 per incident, giving a total loss of \$218 267. If there are commercial alarms in the community, 440 units suffer a successful break-in rate of 0.04776, giving us an expected number of burgled, alarmed properties of 21.01. Adding the expected number of break-ins to the remainder of the population yields 52.01 incidents. Now, applying the average loss per incident yields expected losses of \$29 078 in alarmed, and \$94 502 in non-alarmed businesses. The difference between these two states of the world, alarms vs. no alarms ((2) + (3) - (1) = 29 078 + 94 502 - 218 267), \$94 687 is the amount of prevented losses attributed to commercial alarms.

As noted above, about 2% of alarmed properties are unsuccessful attempts, where intruders have been scared off by the alarm's activation. This means that $0.02 \times 440 = 8.8$ properties suffered no loss. They would have each lost \$1817 had they not had an alarm. Thus, losses avoided by unsuccessful burglary attempts on commercial establishments are \$15 990.

Table 2
Direct costs and benefits of commercial alarms in the community

	No. commercial alarms in the community (1)	Equipped (2)	Unequipped (3)
Commercial units	776	440	336
× Burglary rate	0.15480	0.04776	0.15480
Expected number of burglaries	120.12	21.01	52.01
× Loss per Burglary	\$ 1817	\$1 384	\$ 1817
Total expected loss	\$218 267	\$29 078	\$94 502

The demoralization costs reflect emotional costs associated with the trauma of the invasion of privacy, feeling of vulnerability, and loss of items of sentimental value. About 62% of burgled commercial units reacted to burglary by installing alarms. Installing alarms provides valuable protection against future burglaries. Therefore, paying for alarms today prevents the owners from buying an alarm in the future and of being burglarized in the future. Accordingly, the annualized cost of alarm installation, and the monthly charges may be a conservative estimate of the non-monetary costs which are not recovered by insurers. The annualized demoralization costs associated with burglary avoided by alarm owners are both in installation and in the monthly payments. The installation cost component consists of:

- Burglarized businesses that install alarms: 0.62
- unit cost: \$3200
 - capital recovery rate: 0.10296
 - number of alarmed firms expected not to be burgled: 437.9
 - after tax cost: 0.66
- = \$59 038.

The second component in the calculation of the demoralization costs is the monthly charges which can be estimated as follows:

- Burglarized firms that install alarms: 0.62
- monthly charges: \$100
 - months: 12
 - capital recovery rate: 0.10296
 - number of alarmed businesses expected not to be burgled: 437.9
 - after tax cost: 0.66
- = \$22.139.

Thus, the total commercial demoralization cost is equal to \$81 177.

Most alarms provide protection against burglaries and fire. About 0.0238 of the commercial units in the sample claimed that their alarm systems detected fires. Fire at alarmed properties cause minimal damage due to early detection. If those businesses had no alarm system, an additional 18.47 commercial units would have had a fire. Using national figures [4], average loss due to fire in the United States is \$10 199. This is a very conservative measure for the commercial establishments in this affluent community. Thus, avoided fire attributed to commercial alarms totals annually to \$188 376.

Demoralization costs also accrue from fire loss. Again, just as in the case of burglary, these costs

pertain to devastation associated with the destruction of the business and loss of business records which have no resale value. Estimation of such losses is difficult, and maintaining our conservative approach we chose not to give them any monetary value.

Finally, we consider the insurance discounts on policy premiums for alarm owners. The nature of the discount and its level vary significantly among companies and among businesses. Using a conservative estimate of \$750 for annual premiums and a 10% discount yields an additional benefit of $\$75 \times 440$ for commercial alarmed units = \$33 000.

The total benefits of commercial alarm ownership to the Tredyffrin township sum to \$502 371. These are conservative estimates of avoided losses due to the existence of alarms in the township.

The total residential and commercial benefits to the township is estimated conservatively to be:

$$\$1\,080\,905 + \$502\,371 = \$1\,583\,276.$$

3. The balance of costs and benefits

In this section, the balance of costs and benefits is presented, first for the residential units and then for the commercial units. Table 3 provides the summary estimate of the costs and benefits which resulted from residential alarm systems. It shows that the net benefit of the 1818 systems is \$68 016. Thus, overall, resi-

Table 3
Total costs and benefits of residential alarms to the community

A. The cost variables are:	
1. To owners	
Installation outlays	420 035
Monthly Charges	453 773
2. To the Police Department	
Response to false activations	139 081
Total costs	1 012 889
B. The benefit variables are:	
1. Avoidance of burglaries	
Cost of violent crimes (assault and rape)	77 624
Cost of property stolen	
Cost to homeowners	69 012
Incomplete burglary	60 264
Demoralization costs	426 091
2. Avoidance of fires	
Cost to homeowners	22 939
Cost to insurers 334 075	
Demoralization costs	NA
Insurance discount	90 900
Total benefits	\$1 080 905
Net benefits	\$ 68 016

dential alarms are beneficial to the community. The community includes alarm owners, the police department, township officials and non-alarm owners. It is likely that one group bears costs and another enjoys the benefits. For example, the police department bears the costs of responding to alarms and alarm owners enjoy additional security. Application of real costs and transfer of costs or benefits may raise the efficient use of alarms. For example, the fee charged for false activations should be the average cost to the police department of answering these calls. Currently, the amount collected by the township for false activations enters the township's general fund. Thus, rising costs of alarm response and subsequent increased collection of fees are not channelled to the police department which bears the actual costs. These charges should be transferred to a special fund for the police department to be used solely to cover police costs of responding to false activations.

It is important to note that the one element in Table 3 which gets most attention is the cost to the police department of responding to commercial false activations (\$139 081). However, the overall picture is more important to township officials who must reconsider local ordinances restricting alarm installation.

Table 4 provides the summary estimates of the costs and benefits resulting from commercial systems alone. It shows that the net benefit of the 440 systems is \$112 026. Thus, overall, commercial alarms are beneficial to the community. The overall net benefits to

the community from residential and commercial burglary and fire alarms is summarized in Table 5. The net total benefit is \$180 042.

4. Conclusions

In this chapter, we calculated whether the benefits from burglar alarms outweigh the costs. On the benefit side is the prevention of break-ins and on the cost side is the cost of responding to false activations. It shows that the total benefits accruing to the community in the form of enhanced security outweigh the costs of installing residential and commercial alarms and responding to false activations. Homeowners and businessmen install alarms because they believe that their private benefits are greater than the associated private costs. The benefit is the perceived greater security and the cost is the fines to be paid for false activations. Individuals can be trusted to make correct decisions provided they bear all associated costs and benefits. What is good for the individuals is not necessarily good for the community as a whole. An overall assessment requires the consideration of external costs and benefits. External costs include police response to alarms while external benefits include arresting burglars and 'taking them out of circulation'.

Costs and benefits were conservatively calculated. Costs are biased upwards, and benefits downwards. The external benefits associated with an alarm's effect on deactivating burglars was not taken into account. Still, alarms appear to be beneficial to the community. Benefits outweigh the costs by \$180 042. Sixty-two percent of it is attributed to commercial alarms, and the remaining 38% to residential alarms.

Table 4
Total costs and benefits of commercial alarms to the community

A. The cost variables are:	
1. To business owners	
Installation outlays	95 679
Monthly charges	257 875
2. To the Police Department	
Response to false activations	36 791
Total costs	390 345
B. The benefit variables are:	
1. Avoidance of burglaries	
Cost of violent crimes	89 141
Cost of property stolen	
Cost to businesses	94 687
Incomplete burglary	15 990
Demoralization	81 177
2. Avoidance of fires	
Cost to business	188 376
Demoralization costs	NA
Insurance discount	33 000
Total benefits	\$502 371
Net Benefits	\$112 026

Table 5
Total costs and benefits of alarms to the community

A. Total costs to the community:	
Total residential costs	1 012 889
Total commercial costs	390 345
Total costs to the community	1 403 234
B. Total benefits to the community:	
Total residential benefits	1 080 905
Total commercial benefits	502 371
Total benefits to the community	1 583 276
C. Net benefits	
Net residential benefits	\$68 020
Net commercial benefits	\$112 026
Net benefits to the community	\$180 042

This work provides policy prescription for municipal officials. They should consider redistributing fees collected from alarm owners to the police, who bear the costs associated with the alarms. For example, the total amount of users' fees collected in 1990 was only \$14 796. The amount collected did not cover the real costs to the police department. Further, the money was credited to the general fund of the township. Thus, the township is still underpaid for its real costs. Efficient use of alarm related collections can be achieved if the following two conditions are fulfilled. First, the fines should represent the real costs to the department. Hence, each and all false activations will be charged a flat fee of \$70 per false activation. The amount should represent the long-run average costs associated with false alarms. Second, the police department should enjoy all receipts associated with alarms and should use this amount to provide alarm-related services. In this case, so much friction would

not exist between the police and alarm owners. The police would benefit (or at least break even) and the public would benefit from the increased security allowed by alarm installation.

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