NBER WORKING PAPER SERIES

AN ANALYSIS OF FIRM DEMAND FOR PROTECTION AGAINST CRIME

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Working Paper No. 59

CENTER FOR ECONOMIC ANALYSIS OF HUMAN BEHAVIOR AND SOCIAL INSTITUTIONS
National Bureau of Economic Research, Inc.
261 Madison Avenue, New York, N.Y. 10016

October 1974

Preliminary; Not for Quotation

This research was partially supported by a grant (No. 73-NI-99-1005) from the Manpower Development Assistance Division of the Law Enforcement Assistance Administration to Columbia University.

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It is well known that as a result of spiralling crime rates, public expenditures for police protection have been rising at a rapid rate. It is less well known, however, that private expenditures for guards, protective services and equipment have kept pace with the increasing public expenditures. The data in Table 1 show that during the 1960's per capita private protection expenditures and per capita public protection expenditures both rose by 75 per cent in constant dollars. Despite the fact that in 1970 the private sector allocated at least $3.3 billion of its resources to protection,[1] and this sum is two-thirds the size of the corresponding public outlay no one has explicitly analyzed the determinants of the private sector's demand for protection.[2]

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[1] Total private protection expenditures are certainly underestimated by the figures in Table 1 since a complete measure of private outlays would include the cost of substituting taxi rides for subway trips, keeping lights on at night, staying home after dark, etc.

[2] Three other research projects that analyzed private protection but did not estimate demand functions are J. Kakalik and S. Wildhorn, Private Police in the United States, The Rand Corporation, 1971; Neil Komesar, "A Theoretical and Empirical Study of Victims of Crime," Journal of Legal Studies, Volume 2, June 1973; and Tim Ozenne, "The Economics of Bank Robbery," Journal of Legal Studies, Volume 3, January 1974.

TABLE 1

Per Capita Amounts of Public and Private Outlays for Protection

	1960	1970
Public police protection	11.28	24.50
Constant dollars[a]	(10.94)	(19.19)
Private guards, protective services and equipment	7.33	16.20
Constant dollars[a]	(7.11)	(12.69)

[a]1957-59 = 100.

Sources: Public expenditure data for 1960 are from U.S. Bureau of the Census, Historical Statistics on Governmental Finances and Employment, 1967 Census of Governments, Volume 6, 1969.

Public expenditure data for 1970 are from U.S. Law Enforcement Assistance Administration and U.S. Bureau of the Census, Expenditure and Employment Data for the Criminal Justice System: 1970-71, 1973.

Private expenditure data are from J. Kakalik and S. Wildhorn, Private Police in the United States, The Rand Corporation, Volume 2, 1971.

This article, which summarizes a larger study,[3] attempts to fill this gap by considering firm demand for protection. Since about 85 per cent of total private security spending is by firms an analysis that concentrates solely on firms explains almost all of the private sector's security

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[3]See Ann P. Bartel, "The Demand for Private Protection," Ph.D. dissertation, Columbia University, Department of Economics, 1974.

outlays. The main purpose of this article is to answer three questions. One, how is firm demand for protection related to business losses from crime and the probability of crime? Two, are public and private expenditures substitutes or complements? Three, does a firm choose self-protection as a substitute for market insurance or will it spend more on protection if it has insurance?

Part I describes a theoretical framework for analyzing a firm's protection decisions. In Part II I discuss the data set that is used to test the model and the methods of proxying some of the unobserved theoretical variables. Part III presents the results of the empirical analysis. In Part IV the data are used to test what factors, holding protection expenditures constant, predict whether or not a firm will be victimized.

I. THEORETICAL FRAMEWORK

A. The Model

A firm's decision to purchase protective services and/or market insurance can be analyzed within the context of the "state preference" approach to behavior under uncertainty. Ehrlich and Becker have developed an expected utility model within this context to analyze protection and insurance decisions of individuals.[4] In what follows I apply their basic framework to firms but make several important extensions on their model.

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[4] See I. Ehrlich and G. S. Becker, "Market Insurance, Self-Insurance, and Self-Protection," Journal of Political Economy, Volume 80, July 1972.

The firm is assumed to produce an output X using two inputs: M, which is hired labor measured in manhours, and T_m, which is the entrepreneur's time.[5] For simplicity, X is assumed to be produced according to a Cobb-Douglas decreasing returns to scale production function:

$$X = AM^{\alpha} T_m^{\beta} \quad \text{where} \quad \alpha + \beta < 1 \tag{1}$$

The firm is also assumed to be subject to the possibility of losses from crimes such as burglary, robbery, vandalism, shoplifting and employee theft. These losses will be denoted L (a composite loss) where L (measured in dollars) is a function of factors that are exogenous to the firm as well as being a function of the size of output:

$$L = L\ (L^e, X) \tag{2}$$

L^e, the so-called endowed or exogenous loss is determined, by among other things, the firm's industry group and its location (i.e. urban vs. nonurban). Type of industry can affect L^e in one of two ways: the ease with which merchandise can be transported and the accessibility of the merchandise. For example, a bank would have a higher L^e than a manufacturing plant of the same size since banks hold a larger inventory of

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[5]I have ignored the obvious third input, capital, because I primarily wish to emphasize the market-nonmarket dichotomy between certain inputs in the production process. To the extent that I am dealing with short-run decisions by the firm, capital could be treated as a fixed factor and need not enter the short-run production function.

cash; while the cash is not readily accessible, it is easily transportable once the criminal has access to it and this would enable him to steal a larger dollar amount from a bank than from a manufacturing plant for any given criminal action against these two firms. Alternatively, if one compared a retailer with a service firm of the same size one would expect the retailer to have a higher L^e since his output is readily accessible to customers, employees, and burglars, whereas the output of a service firm is usually not a tangible item. The effect of location on L^e is less clear. An urban firm might have a higher L^e than a nonurban firm since the high population density of urban areas would result in an urban criminal being more likely to take the risk of stealing a larger amount than a nonurban one because he could be less easily detected.

It should be noted that I am assuming that type of industry and location are fixed for the short-run decisions of the firm which I am analyzing. Of course, in the long run the firm could affect L^e by moving to a new neighborhood or changing the nature of its business.

X, the size of output, has a positive effect on L since the more the firm produces the larger its potential losses. While protection expenditures can reduce the probability of a loss they are assumed not to reduce the size of the loss.[6] This relationship enables me to

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[6]For example, the main function of a security guard is to deter a criminal from attempting to steal from the firm. However, once the crime takes place, the presence of the guard will have little effect on the dollar amount that the criminal is actually able to remove from the store. This distinction between protection affecting probability and not loss is used by Ehrlich and Becker (1972).

assume that $\frac{\partial L}{\partial X} \cdot \frac{X}{L} = 1$, a 1 per cent change in output X results in a 1 per cent change in L and the loss-output ratio remains fixed as firm size increases. This is a valid assumption since I am merely trying to capture a scale effect and there is no obvious reason to assert that L should increase either at a slower or faster rate than X.[7]

The loss, L, is assumed to occur with probability, p, which is a function of exogenous factors as well as decisions made by the firm:

$$p = p(p^e, c) \tag{3}$$

p^e is the endowment or exogenous probability and it is determined by the firm's location and type of product or industry. Again one might expect a retailer to have a higher p^e than a service firm because of the greater availability of merchandise in a retail store. Location in an urban area would result in a higher p^e because of the greater supply of potential criminals.[8] The firm can, however, change p^e by self-protecting. Let c be the level of self-protection where $\partial p/\partial c < 0$ and $p < p^e$ if $c > 0$.

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[7] If protection expenditures could reduce L, then the loss-output elasticity would have to be greater than 1 because this elasticity is computed with protection held constant. Then if the firm were to double its output without changing its level of protection its losses would have to increase by more than 100 per cent.

[8] Urban areas would have a greater supply of potential criminals than nonurban areas because the median family income is higher in urban areas:

(continued on next page)

Self-protection, c, is assumed to be produced according to a decreasing return to scale production function[9] with two inputs: G, guard hours purchased in the market, and T_s, time spent by the entrepreneur policing his firm. Thus since c, self-protection, is some function of G and T_s we can write the p function as:

$$p = p(p^e, G, T_s) \tag{4}$$

For simplicity I have not considered the third protection input, capital, since I am primarily interested in emphasizing the idea that an entrepreneur can purchase protective services not only in the market but also from himself.

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8 (concluded)

	Urban	Rural Nonfarm
Median income	$10,196	$8,248
Per cent below 1/2 median	19%	20%

Source: 1970 Census of Population, General Social and Economic Characteristics, Table 105.

Ehrlich (1973) has shown that when income inequality is held constant, median family income has a positive effect on crime rates because it measures the criminal's potential illegal payoff.

[9] Decreasing returns to scale is required by the second-order maximum condition. See Appendix A in Bartel (1974).

The role of the entrepreneur as a policeman can be compared to the analysis by Alchian and Demsetz of the entrepreneur as the monitor of team production who reduces shirking by team members.[10] They show that the monitor has the incentive not to shirk as a monitor because he has title to the net earnings of the team. Similarly, in my model, the entrepreneur has an incentive to reduce the probability of crime against the firm because in that way he maximizes the net earnings of his firm. Any other non-guard employee would not have this incentive and he might in fact try to steal from the firm.

The function in (4) has the following properties: An increase in G reduces p and an increase in T_s reduces p. Also $\frac{\partial p'G}{\partial G} > 0$ and $\frac{\partial p'T_s}{\partial T_s} > 0$; G and T_s have diminishing marginal products. In addition it is assumed that $\frac{\partial p'T_s}{\partial G} > 0$; an increase in the number of guard-hours reduces the marginal product of one hour of own policing time. This occurs since guards and entrepreneurial time perform essentially the same type of protective service and the deterrent effect of an increase in guard-hours reduces the contribution that T_s makes to a reduction in

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[10] See their "Production, Information Costs, and Economic Organization," AER, 62, December 1972. Their model requires the entrepreneur to specialize in monitoring whereas I view the entrepreneur as playing two roles, that of policeman and that of production input (in this latter role he could in fact be a monitor). Another article dealing with the entrepreneur's enforcement role is M. Silver and R. Auster, "Entrepreneurship, Profit, and Limits on Firm Size," *Journal of Business*, 42, July 1969.

p. While one could argue that the cross-partials should be negative (i.e., the marginal products increase) since the hiring of a guard may enable the entrepreneur to allocate his policing time more efficiently (i.e., a division of labor effect) it seems more likely that the opposing effect dominates, especially as guard time is increased, since division of labor would only be important when guard usage is first introduced.[11] In spite of the positive cross-partials, however, the self-protection isoquants are still assumed to be convex.[12]

Given that the firm faces two states of the world, the no-loss state and the loss state (where losses L occur), it maximizes the expected utility of its net income prospect:

$$U^* = (1-p)\ U\ (I_1) + pU\ (I_1 - L) \tag{5}$$

subject to the production function for output X in (1), the constraint on L in (2), the constraint on p in (4), and a constraint on the entrepreneur's time:

$$T = T_s + T_m \tag{6}$$

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[11] One other possible source of complementarity is that the entrepreneur must police the guards themselves. I have, however, ignored or at least minimized the importance of this relationship.

[12] Convexity is required by the second-order maximum conditions. See Appendix A in Bartel (1974).

where T is the total time the entrepreneur spends on the job, T_s is the entrepreneur's policing time, and T_m is the time he allocates towards producing output X.[13] If initially we assume that insurance is unavailable to the firm, net income can be expressed as:

$$I_1 = kX - wM - w_G G \qquad (7)$$

where k is the market price of the output and is assumed fixed for the firm, w is the wage rate of the hired input (also constant) and w_G is the wage rate of security guards (also constant for the firm).

If the firm is risk neutral it maximizes expected profits and equation (5) reduces to:

$$\pi^* = kX - wM - w_G G - pL \qquad (8)$$

The firm maximizes π^* with respect to the variables it controls: M, G, and T_s, subject to the four constraints. Internalizing the constraints, the resulting first order conditions are:

$$\text{C-1} \quad (k - p\frac{\partial L}{\partial X})\ \frac{\partial X}{\partial M} = w$$

$$\text{C-2} \ - p'_G L = w_G$$

$$\text{C-3} \ - p'_{T_s} L = (k - p\frac{\partial L}{\partial X})\ \frac{\partial X}{\partial T_M}$$

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[13] T is fixed because the amount of leisure and consumption time are assumed to be previously determined.

Condition C-1 states that in equilibrium the marginal revenue from hiring an additional manhour, M, must equal the marginal cost of hiring him. Note that labor is not paid the value of its marginal product $k\partial X/\partial M$; rather there is a wedge between the wage and the VMP that is equal to the expected loss due to hiring the extra manhour and thereby increasing output. Condition C-2 states that the marginal revenue from hiring an additional guard hour must equal the guard wage rate. Condition C-3 states that the marginal revenue from using an additional hour of own policing time must equal the marginal cost of that hour. Note that the marginal cost of own time, T_s, equals the value of the foregone output X adjusted for the decrease in the expected loss due to the cut-back in output X. Whereas the entrepreneur can purchase guard time at constant cost, the marginal cost of T_s is increasing since T_m has a diminishing marginal product and since p falls as T_s is increased. In addition, since G reduces p, the price of T_s is not independent of the number of guard hours the firm hires.

Conditions C-2 and C-3 can be combined to form the equilibrium condition

$$\frac{p'G}{p'T_s} = \frac{w_G}{(k - p\frac{\partial L}{\partial X})\ \frac{\partial X}{\partial T_m}} \tag{9}$$

which states that the ratio of the marginal products of the two protection inputs must equal the ratio of their marginal costs. This equilibrium condition can be represented as in Figure 1:

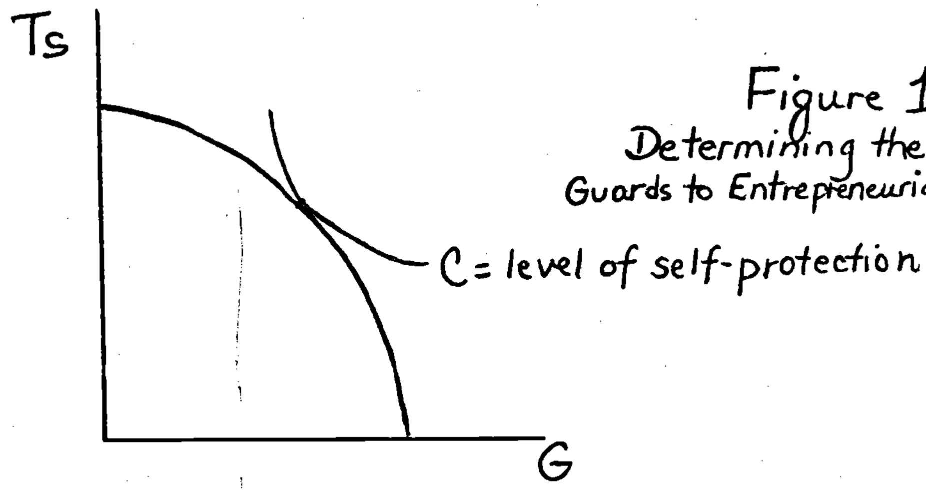

Figure 1
Determining the Optimal Guards to Entrepreneurial Time Rati[o]

Since G and T_s are imperfect substitutes the self-protection isoquants are convex. The slope of the isoquant equals $\frac{p'G}{p'T_s}$. The transformation curve, whose slope equals $\frac{w_G}{(k-p\frac{\partial L}{\partial X})\ \frac{\partial X}{\partial T_m}}$, is nonlinear because T_s can not be purchased at constant cost. Equilibrium occurs at the tangency of an isoquant and the transformation curve.

Equation (9) points out that guards and entrepreneural time are asymmetric in the sense that an increase in G reduces p while an increase in T_s reduces p and L. (This asymmetry has important implications for comparative statics predictions as will be shown below.) Another distinction between G and T_s is that there may be some "lumpiness" in the hiring of guards. For example the optimal decision for a small firm might be to hire a guard for fifteen minutes out of every hour but contractual constraints would not permit this arrangement. Entrepreneurial time, on the other hand, could be adjusted more precisely. Therefore small firms might be forced to specialize and only use T_s to produce protection.[14]

B. Comparative Statics Predictions

By differentiating the first order conditions at the maximum the effects of several exogenous factors on the amounts of G and T_s that are used can be determined. Complete explanations and proofs of these results can be found elsewhere;[15] a brief summary of the predictions is presented here.

1. An increase in the guard wage rate results in a decrease in the number of guard hours hired and an increase in the amount of the entrepreneur's time used in self-protection.

2. An increase in the parameter β in the production function in (1) causes an increase in guard hours and a decrease in the entrepreneur's time.

3. An increase in the endowed loss results in an increase in both G and T_s.

4. An increase in the endowment probability will cause an increase in both G and T_s if the increase in p^e raises the marginal products of the two protection inputs.[16]

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[14] Small firms could avoid this problem by organizing in a group which would hire a full-time guard. Each firm could then get a few minutes out of every hour of the guard's time. An alternative solution may be to hire a guard just for a few key hours out of every day.

[15] See Bartel (1974), Chapter II and Appendix A.

[16] If the marginal products of G and T_s are unchanged then we have $\frac{dT_s}{dp^e} > 0$ because the marginal cost of T_s falls (see condition C-3) and

(continued on next page)

5. An increase in public protection expenditures will reduce G and T_s if their marginal products fall as a result of the increased level of public protection.

6. If an increase in the education of guards raises their marginal productivities, then holding w_G constant, this will result in an increase in G and a decrease in T_s.

7. An increase in the entrepreneur's experience will cause an increase in G and a decrease in T_s if experience has a relatively larger effect on the entrepreneur's marginal product in output production than on his marginal product in protection.[17]

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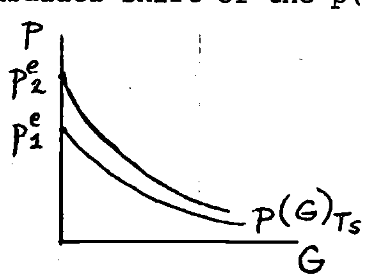
16 (concluded)

$\frac{dG}{dp^e} < 0$ because losses fall since M and T_m are reduced and the marginal product of G falls because T_s rises. I am postulating that the guards and entrepreneurial time that are currently employed should become more valuable after an exogenous increase in the crime rate. The protection inputs would have a higher marginal product, the higher the initial p^e, since, it is easier to reduce the probability from, for example, .8 to .7 than it is to reduce it from .5 to .4. Diagrammatically this could be pictured as a nonparallel shift of the $p(G)_{T_s}$ and $p(T_s)$ functions:



[17] We have $\frac{dT_s}{dEXP} \gtrless 0$ as $\frac{dp'T_s}{dEXP} \frac{EXP}{p'T_s} \gtrless \frac{d\frac{\partial X}{\partial T_m}}{dEXP} \frac{EXP}{\frac{\partial X}{\partial T_m}}$

If T_s increases then G will fall because G's marginal product falls and because losses fall as a result of the decrease in T_m.

In the expected utility literature it is often noted that a 1 per cent change in L^e has the same, larger or smaller percentage effect on expected utility as does a 1 per cent change in p^e according to whether the individual is risk neutral, risk averse or a risk preferrer; hence the deterrent effect on a criminal of a 1 per cent increase in the probability of apprehension exceeds, equals, or falls short of the effect of a 1 per cent increase in the fine according to whether he is a risk preferrer, risk neutral, or a risk avoider.[18] A similar test can be applied to the protection response of firms to an increase in L^e and an increase in p^e. In my model, even though firms are assumed to be risk neutral, a 1 per cent change in L^e has a larger percentage effect on G than does a 1 per cent change in p^e.[19] The reason for this is that when the increase in p^e takes place, the firm can maximize expected profits not only by hiring G, but also by hiring fewer M and thereby

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[18]See Gary S. Becker (1968) and Issac Ehrlich (1973) for proofs of this result.

[19]See Bartel (1974), Appendix A for proof. Note I assume there that $\frac{\partial p'G}{\partial p^e} \frac{p^e}{p'G} = \frac{\partial p'T_s}{\partial p^e} \frac{p^e}{p'T_s} = 1.$ As $\frac{\partial p'G}{\partial p^e} \frac{p^e}{p'G}$ becomes larger than 1, Ep^e rises relative to E_{L^e} and equality or even $Ep^e > E_{L^e}$ could result. Since I have no prior information on the size of $\frac{\partial p'G}{\partial p^e} \frac{p^e}{p'G}$ assuming it to be equal to one is the most neutral assumption.

reducing losses. Since the loss itself is endogenous the firm has another alternative when p^e rises; this alternative is usually ignored in the standard expected utility models.

In the case of the entrepreneur's time, if the loss is completely exogenous, a 1 per cent increase in L^e will have the same relative effect on T_s as will a 1 per cent increase in p^e, the usual risk neutral result. But since my model treats the loss as endogenous, risk neutrality results in a 1 per cent increase in L^e having a smaller relative effect on T_s than does a 1 per cent increase in p^e. This is because the increase in p^e reduces the marginal cost of T_s thus causing a further expansion of T_s beyond that of the case of an exogenous loss.[20]

C. Risk Aversion and the Availability of Insurance

If the assumption of risk neutrality is relaxed such that the firm's utility function now has a negative second derivative then the firm maximizes the utility function in (5). Introducing insurance into the model requires the insurance premium, q, to be subtracted from I_1, income in state one, and the quantity A-q to be added to income in state zero where A is the amount of insurance the firm purchases and $q = \lambda pA$. If insurance is actuarially fair, $\lambda = 1$, and all the predictions derived above hold since the firm acts as if it were risk neutral.

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[20]Although M is reduced when p^e rises and this lowers L, $\varepsilon T_s, p^e$ is not reduced because the reduction in M also lowers the marginal cost of T_s and these two factors are perfectly offsetting:

$$\frac{d(C-3)}{dM} = 0 \quad \text{because} \quad \frac{\partial L}{\partial X}\,\frac{X}{L} = 1.$$

The effect of insurance on the demand for guards and entrepreneurial time is unclear. An increase in A reduces the net loss to the firm and the marginal gain from self-protecting either via G or T_s diminishes. This is the source of the moral hazard problem; if a firm has loss coverage it has no incentive to reduce the probability of the loss occurring. On the other hand, an increase in G or T_s reduces the price of insurance since p falls and $q = \lambda pA$, thereby implying a complementary relationship between protection and insurance. However one would expect to observe a stronger complementary relationship between guards and insurance than between entrepreneur's policing time and insurance because there is an additional negative relationship between T_s and A that does not exist for G and A; that is, an increase in T_s reduces L since output falls and the reduction in L lowers the demand for insurance.

D. Industry Equilibrium

The model described above considered the reactions of a single firm in a competitive industry to losses from various crimes. One of the basic assumptions of the model was that the firm could not affect the price of its output. Although crime increased the firm's costs the firm reached an equilibrium by producing that output where its new marginal cost equalled the fixed market price. However, as discussed in Section A, all firms in a particular industry in a given location will be faced with a certain amount of crime as described by the variables p^e and L^e. Since all of these firms will face higher marginal cost curves as a result of crime the industry supply curve will shift to the left and the market price will rise. Of course if one firm in the industry is especially vulnerable to crime it may be forced out of business since the leftward shift in its marginal cost curve will outweigh the increase in the market price; the intersection of its marginal cost curve and its horizontal demand curve may only occur at an output of zero units.

Since firms in different industries in a particular location and firms in a single industry in varying locations will face different endowed losses and endowed probabilities one would expect to observe changes in relative prices across these groups. For example, if over time, crime against retailers increases relative to crime against service firms, then one should observe an increase over time in the price of retail goods relative to the price of services, holding location and other shift factors (e.g., technological change) constant. Alternatively, if crime against urban firms increases over time relative to crime against nonurban firms then one should observe an increase over time in the price of retail goods in urban areas relative to the price of retail goods in nonurban areas.

Similar predictions would hold in the cross-section. Using data on industries in a given location and choosing one industry as the numeraire, a regression of industry price on demand factors and supply factors should yield positive signs on the independent variables measuring the probability of crime in the industry and the endowed loss in the industry.

E. Reaction of Offenders

The model as developed up until this point is still only a partial equilibrium model. It is a model of how firms react to the possibility of losses from various crimes and describes how market prices are affected by crime. One assumption of the model was that if a crime took place, a firm would lose \$L where L was determined by L^e, a set of exogenous factors, and X, size of output. Each firm, therefore, had a specific L. Why is it that the market can tolerate loss differentials across firms? The answer lies in the fact that the offender's cost of committing a crime will differ across firms. In evaluating possible targets, the offender considers a net return function for each firm:

$$N_i = (1 - f_i) L_i - R_i - f_i F_i \tag{10}$$

where L_i is the gain to the criminal if he successfully carries out the crime, f_i is the probability of his being apprehended, R_i is his resource costs in perpetrating the crime, and F_i is the punishment for committing the crime. For simplicity I assume that all offenders have equal productivities so that every offender has the identical net return for the i^{th} firm.[21]

The firm is able to raise f_i and R_i by self-protecting. If the entrepreneur hires a guard and/or spends his own time policing, the

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[21] T. Ozenne (1974) also makes this assumption in developing his general equilibrium model of theft and protection.

probability of a criminal being apprehended in his store increases and moreover, the criminal may have to engage more of his own resources in order to successfully commit a crime in this store. The entrepreneur has the incentive to increase f_i and R_i because this will reduce the probability of a crime being committed against his firm and expected profits will thereby increase. Also, he can reduce L_i by cutting back on his output. F_i is presumably out of the entrepreneur's control since it would be decided by public officials.

Then, in order for the market to tolerate loss differentials across firms, net returns to crime must be equalized across firms. This implies that, in the cross-section, the occurrence of higher losses, L_i, should be associated with higher expected punishments and higher criminal resource costs.

II. EMPIRICAL SPECIFICATION

Data limitations make it impossible to test all of the implications of the theoretical model. The market equilibrium conditions discussed in Sections D and E of Part I are not considered in the empirical work. Moreover only those comparative statics predictions outlined in Sections B and C of Part I that deal with the demand for guards are tested here.

A. The Data

The data set used to test some of the implications of the theoretical model is the Small Business Administration's 1968 Survey of Crime Against

Business.[22] While the survey was performed by the Small Business Administration, it should be pointed out that the survey was not limited to small businesses; in fact annual gross receipts for the firms included in the sample ranged from under $10,000 to over $10,000,000. The survey was designed to measure business losses from various crimes and protection decisions and expenditures by individual firms. The sample of firms was selected from corporate and business tax returns for fiscal years ending between July 1, 1965 and June 30, 1966. After excluding returns filed for agriculture, forestry, and fishery businesses, the sample was stratified by type of business ownership and by size of business receipts. A self-weighted 1 in 1,400 sample was then selected; however, only 50 per cent of the businesses were actually interviewed in the summer of 1968 resulting in a final group of approximately 2,450 firms. I reduced the sample to 1,941 firms because many firms failed to provide information on their losses and protection expenditures.

The crime categories included in the survey were shoplifting, burglary, robbery, vandalism, and employee theft.[23] The Small Business Administration asked each firm to give dollar amounts for each of the above types of loss that it incurred during the twelve-month period

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[22]See U.S. Small Business Administration, "Crime Against Small Business," a Report Transmitted to the U.S. Senate, U.S. Government Printing Office, 1969, for a complete description of the survey.

[23]The firms were also questioned about their losses from bad checks but I excluded these losses.

prior to the date of the interview, i.e., between July 1967 and July 1968.[24] Table 2 shows the distribution of the reported losses broken down by type of loss and location of firm. The relatively low loss figures in lines 1 and 4 are explained by the fact that many firms experienced no losses at all. Among those firms with a loss, however, the average loss for urban firms was $1,400 while for nonurban firms it was $600. While urban firms incurred larger losses than nonurban firms in every category the distribution of the total losses into the separate categories differs by location. Burglary and vandalism comprise 64 per cent of urban losses but represent only 51 per cent of nonurban losses; employee theft and shoplifting account for only 33 per cent of urban losses but they comprise 46 per cent of nonurban losses.

B. Demand for Guards Equation

The basic reduced form equation from Part I which will be tested on the Small Business Administration data is as follows:

$$\begin{aligned} \text{Guards} = a &+ b_1 \text{ Endowed Loss} + b_2 \text{ Endowed Probability} \\ &+ b_3 \text{ Public Protection} + b_4 \text{ Wage of Guards} \\ &+ b_5 \text{ Education of Guards} + b_6 \text{ Experience of} \\ &\text{Entrepreneurs} + b_7 \text{ Insurance} + u \end{aligned} \tag{11}$$

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[24] The firms actually picked a loss interval into which their loss fell. I used the midpoint of the interval to measure the actual loss value. For the open-ended intervals arbitrary values were used but very few firms had losses which fell into these upper intervals.

TABLE 2

Distribution of Losses

	Shop-lifting	Burglary	Robbery	Vandalism	Employee Theft	Total Losses
Urban						
1. Average losses	131.33	234.31	16.35	215.50	102.74	700.17
2. Fraction of firms with a loss	.14	.18	.04	.33	.08	.50
3. Average losses for those firms with a loss	931.42	1,316.35	441.89	657.01	1,252.93	1,397.54
Nonurban						
4. Average losses	60.13	59.74	4.42	49.73	38.54	212.59
5. Fraction of firms with a loss	.14	.10	.01	.21	.06	.36
6. Average losses for those firms with a loss	438.91	597.40	315.71	239.09	688.21	593.83

The empirical proxies of the theoretical variables are discussed below.

C. Dependent Variables

The SBA asked each firm whether or not it (a) employed a guard or watchman or hired a guard through a security guard service, or (b) subscribed to a protective service. Firms that did subscribe to a protective service were asked to give the monthly fee they paid for this service. The difference between a guard or watchman and a protective service is in the amount and type of protection each provides. A guard is assigned to patrol a store for a specified period of time. Hence, if he works for a retailer during the day, he is able to reduce the probability of shoplifting, employee theft and robbery. If he is a night watchman for a manufacturing plant his primary responsibility is to reduce the probability of burglary and vandalism. If a firm subscribes to a protective service, however, it does not get full-time protection from a guard or watchman. Rather a group of firms, in one neighborhood, hires a guard service to patrol the entire area and each individual firm, therefore, may receive only a few minutes of actual protection out of every hour that the guard is on duty in the neighborhood. Since a protective service patrols outside the store and usually at night, the service is primarily aimed at reducing the probability of burglary and vandalism. The average monthly expenditures for these protective services is approximately $50. Moreover, 7 per cent of the firms in the sample reported subscribing to a protective service while 6 per cent reported that they had a guard.

Since the SBA survey made the above distinction between the two types of guard service, I was able to test the model in Part I using two dependent variables. Unfortunately, the data only enabled me to approximate the number of guards by a dummy variable (GD) which equals one if the firm has a guard and zero if it does not. The presence or absence of a protective service is similarly measured with a dummy variable (PSER).

D. Independent Variables

1. Estimate of the endowed loss (L^e)

The model in Part I assumes that the firm has some subjective measure of L^e, the dollar loss that it will incur given that a crime takes place and also ignoring scale effects (i.e., the effect of size of output on absolute losses). L^e was assumed to be determined by the type of industry and location of the firm. The empirical specification in equation (11) requires that a dollar figure be assigned to each firm to measure its L^e. I assume that the i^{th} firm decides what its L^e is by looking at the recent loss experience of other firms that have similar industry and location characteristics. The i^{th} firm looks at the losses experienced by these firms in the previous twelve months and uses this information to predict what it thinks its own L^e will be for the coming period. In other words, if firms in the surrounding neighborhood (or in the same industry) have been experiencing very high losses, (when a crime takes place), the i^{th} firm in that neighborhood (industry) realizes that it faces a high L^e and it will be more likely to hire a guard than a firm in a neighborhood (industry) with a low L^e. It is not important that the i^{th} firm might have had the guard during the past year; what matters is that it currently has a guard and this is in part determined by its estimation of the losses it thinks it will incur in the next few months if a crime is committed against the firm.

The estimation of L^e requires grouping the firms in the sample into cells of "similar" firms. I used two grouping methods. For the first method, the firms were stratified by industry group (nine categories), urban/nonurban, and three size categories (gross sales less than $50,000, between $50,000 and $500,000, and greater than $500,000), resulting in fifty-four cells. Although the theoretical model describes L^e as being unrelated to size of firm, I used the three broad size categories because there was a tremendous range in the sizes of the firms in the sample and it seemed unreasonable to assume that an urban grocery store with $10,000 gross sales would gain any information from the loss experience of an urban department store with $1,000,000 gross sales. Size, however, is really not held constant in the construction of L^e since within each of the three categories there is still much size variation.

The second grouping method is to stratify by geographic region of the country (nine regions), urban/nonurban, and the three size cells. This method is not as attractive as the first one since it is unlikely that a retailer in a certain area would use the losses of a bank (in the same area) as a measure of its own endowed loss; but stratifying by industry, region, urban and size was impossible because too many small cells would be produced.

After the firms were appropriately grouped, L^e was computed by taking the mean loss in the twelve-month period of those firms in the cell that had a positive loss. The five types of losses were added together in computing this variable (LOSS).

The above argument assumes that the i^{th} firm relies on the loss experience of similar firms in predicting its endowed loss. It is, of course, possible that if the i^{th} firm itself experienced a very high loss during the previous twelve months then the average loss of the other firms may be an underestimate of this firm's L^e for the coming period. On the other hand, a high loss during one particular twelve-month period could be due to special random events in that period and, therefore, the i^{th} firm's actual loss last year may provide no information for its future losses. One could therefore express L^e as:

$$L^e = \bar{L} + \delta_1 (L^a - \bar{L}) \qquad (12)$$

where $\bar{L}$ is the mean loss in the firm's cell, L^a is its actual loss and δ_1 is an adjustment coefficient that lies between zero and one. Information on L^a is, of course, only obtained for those firms (40 per cent of the sample) that had a positive loss during the twelve-month period. Also L^a embodies the scale effect of output on L and size of firm must therefore be held constant in the regression. Of course the importance of a \$1,000 deviation will probably differ if L is \$500 or \$5,000 and therefore a more useful way of incorporating the firm's own loss is to consider the relative deviation of its dollar loss, i.e.

$$L^e = \bar{L} + \delta_1 \frac{(L^a - \bar{L})}{\bar{L}} \tag{13}$$

$\bar{L}$ (LOSS), and the expression in (13) are tested in Part III as empirical estimates of the firm's endowed loss.

2. <u>Estimate of the endowed probability (p^e)</u>

The two methods of grouping described above were also used to compute p^e. For the i^{th} firm, an estimate of its endowment probability is the ratio of the number of firms in the i^{th} firm's cell that reported a loss over the total number of firms in the cell (PROB). The second grouping method, using region rather than industry, may be more appropriate since the fact that a bank in a given area experienced a loss indicates to a retailer in the same area that businesses in the neighborhood are incurring losses from crime; the fact that a retailer in another area experienced a loss would not provide information on the local crime rate but would indicate that retailers are more susceptible to crime than, for example, service firms. Therefore, both methods should provide suitable measures for p^e whereas in the case of L^e the industry grouping should be far superior to the regional grouping.

One problem with measuring p^e in this manner is that the actual incidence of crime in a given cell is determined not only by endowment factors like industry and location but also by the protection expenditures of the firms in the cell.[25] Therefore if $\overline{p}$, the incidence of crime, in one cell is greater than $\overline{p}$ in another cell this could in part be due to the fact that the average protection expenditures of the firms in the first cell are less than those of the firms in the second cell. In order for $\overline{p}$ to measure p^e, the mean protection expenditures in the cell must be held constant. The variable used to construct this mean (AVG) is the total expenditure of each firm on all protective devices that it had purchased up until the date of the interview. Using the average monthly expenditures on protective services would not have been preferable since labor is a variable factor and one cannot be sure that these same expenditures were being made eight or ten months ago since the firm could have easily adjusted its expenditures in response to new information about future losses. While total expenditures on protective devices may also reflect responses to recent events, they do include past expenditures, e.g., an alarm system that was installed a few years ago, so that this variable serves as a much better control for the level of protection during the previous twelve-month period.

Although the relationship between probability and protection expenditures should be nonlinear (because protection has a diminishing marginal

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[25]This problem does not occur for L^e, because according to the assumptions of the model in Part I, protection reduces the probability of a crime, but once the crime takes place, it has little effect on the size of the loss incurred.

product), let us assume that we can express the observed probability in a cell as:

$$\bar{p}_j = \alpha p_j^e + \beta \bar{C}_j \tag{14}$$

where $\bar{p}_j$ is the observed incidence of crime for the j^{th} group, $\bar{C}_j$ is the mean protection expenditures for the group, and β is negative. If $\bar{C}_j$ equals zero **then** $\bar{p}_j$ perfectly measures p_j^e; hence $\alpha = 1$. β, however, is not independent of p^e since an increase in crime rates is assumed to raise the marginal product of the protection inputs.[26] In other words,

$$\beta = \lambda + \gamma p^e \tag{15}$$

where λ is negative since it measures the effect of protection on probability that is independent of the level of p^e and γ is also negative because at a given $\bar{C}$ the slope of the p(C) function is steeper the higher is p^e. Substituting for β in (14) and solving for p_j^e we have:

$$p_j^e = \frac{\bar{p}_j - \lambda \bar{C}_j}{1 + \gamma \bar{C}} \tag{16}$$

and since the i^{th} firm's demand for guards can be written as:

$$G_i = a + b_1 p^e + \beta_2 X \tag{17}$$

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[26] See the discussion in footnote 16.

where X is a vector of all other independent variables, we can substitute for p^e and obtain

$$G_i = a + \frac{b_1\bar{p}}{1+\gamma\bar{C}} - \frac{b_1\lambda\bar{C}}{1+\gamma\bar{C}} + b_2X \qquad (18)$$

where $\bar{p}$ is measured by PROB and $\bar{C}$ is measured by AVG.

The true partial effect of p^e on G_i is b_1, but we observe the coefficient on $\bar{p}$ which is

$$\frac{\partial G_i}{\partial \bar{p}} = \frac{b_1}{1+\gamma\bar{C}} \qquad (19)$$

Since the absolute value of $\gamma\bar{C}$ is less than one[27] the coefficient that we observe overestimates the true effect of p^e on G_i. This happens because we underestimate the true difference between, for example, p_1^e and p_2^e, when we use $\bar{p}_1$ and $\bar{p}_2$. To get b_1, therefore, requires iterating on different values of γ that satisfy $1 > 1 + \gamma\bar{C} > 0$. Note that equation (18) shows that the coefficient that we observe on AVG, $\frac{(- b_1 \lambda)}{1+\gamma\bar{C}}$, will be positive since b_1 is positive and λ is negative.

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[27]Substituting (15) into (14) we have

$$\bar{p}_j = p^e (1 + \gamma\bar{C}) + \lambda\bar{C}$$

Since λ is negative, in order to guarantee that $\bar{p}_j$ lies between 0 and 1, the quantity $1 + \gamma\bar{C}$ must be a positive fraction.

As with the endowed loss, the firm's own experience can be used to modify the estimate of the endowment probability as follows:

$$p^e = \bar{p} - \frac{\lambda\bar{C}}{1+\gamma\bar{C}} + \delta \text{ POSLOS} \tag{20}$$

where POSLOS equals one if the firm had a loss during the previous twelve months and zero if it did not. In Part III, p^e is estimated by the expressions in (16) and (20).

3. Public protection

The level of public police protection in the firm's area is measured by per capita police protection expenditures by state and local governments in the firm's state (PUB) for the government fiscal year ending June 30, 1968.[28] In order to correctly measure the effect of public protection, however, the crime rate in the firm's area must be held constant. For each state it is possible to construct separate crime rates for SMSAs, for other cities, and for rural areas. Since the property crime rate can have an independent effect on the firm's decision to hire a guard or protective service (apart from serving as a control variable for public protection) because it is an alternative way of measuring a firm's p^e, I include only burglary, robbery, and larceny in the construction of the crime variable. Then for the i^{th} firm the value of the local crime rate (CRIME) is the number of burglaries, robberies and larcenies per 100,000 inhabitants in

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[28] From U.S. Department of Commerce, Bureau of the Census, "Government Finances in 1967-68," GF68, No. 5.

areas in the i^{th} firm's state which are similar in size to the i^{th} firm's locality in that state.[29]

4. Price and productivity variables

The real wage of private guards (GDI) is measured by the ratio of the median earnings of male full-time employed guards and watchmen in the state in which the firm is located to a price index computed from the average hourly earnings of manufacturing workers in the state.[30]

The education of guards is measured by the average number of years of school completed by male employed protective service workers in the firm's state (EDUC).[31] Since the protective service worker category includes public policemen and firemen as well as private guards, the ratio of guards to all protective service workers in the state is included (PCT) in the regression equation.[32]

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[29] The crime rate data are taken from U.S. Department of Justice, FBI, Crime in the United States, 1967 Uniform Crime Reports.

[30] Median earnings of guards are from U.S. Department of Commerce, Bureau of the Census, Detailed Characteristics, 1970 Census of Population, Table 175. Hourly manufacturing wages are from U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States: 1970, Table 344. The index is computed by choosing one state's wage as the numeraire and dividing all manufacturing wages by this number.

[31] From U.S. Department of Commerce, Bureau of the Census, Detailed Characteristics, 1970 Census of Population, Table 179.

[32] *Ibid.*, Table 170.

The entrepreneur's experience must be proxied by the number of years the firm has been at its present location (YRS). This variable would be highly correlated with the age of the firm and the firm's age would be a proxy for the owner's experience and hence his productivity as a businessman and as a protector of his firm. There may be a bias due to the possibility of non-mobile firms being in urban, high-crime areas. This can be accounted for by controlling for location in the regression. A description of the location variables is given below in number 6.

5. Insurance

The model in Part I treats insurance as an endogenous variable. Unfortunately the available data do not enable me to identify a system of protection and insurance equations and my empirical analysis assumes that insurance can be used as an independent variable in the demand for guards equation. The firms in the sample indicated whether or not they currently had burglary insurance, robbery or theft insurance, and vandalism insurance. Those firms that reported positive burglary losses also reported how much the insurance company reimbursed them for their loss.

A dummy variable (ANYINS), which equals one if the firm has any type of insurance and zero if it has none, is used to empirically examine the relationship between insurance and protection. Simultaneity may hamper the estimation of the ANYINS coefficient since if a firm hires a guard it is able to purchase insurance at a lower rate and would therefore be more likely to have insurance coverage; a positive coefficient could reflect the influence of protection on insurance.

Using the dollar amount that the firm was reimbursed by the insurance company after a burglary took place (AMTBINS) should avoid this problem. Since the reimbursement took place several months ago, AMTBINS can be treated as an exogenous variable referring to an insurance decision made by the firm in a previous period. GD (PSER) would not have any effect on AMTBINS as long as the firm did not have a guard (protective service) at the time it purchased the burglary insurance policy. While AMTBINS does not really measure the amount of coverage the firm had since the loss could have been less than the face value of the policy, it does capture the effect of insurance on reducing the net loss to the firm. Then if the value of the actual burglary loss is held constant (BGLOS) and a dummy variable for the presence of burglary insurance is also used (BINS), the coefficient on AMTBINS should be negative since it provides information for the firm on how much it can expect to be reimbursed if future burglary losses occur. Of course, if the firm had a guard (or protective service) at the time of last year's burglary then it may have been more likely to have insurance coverage and would therefore report a larger reimbursement; this would bias the coefficient on AMTBINS towards zero. Note that the testing of AMTBINS can only be done on the subset of firms that had positive burglary losses.

6. Other variables

Some other variables not specified in equation (11) are also added. They are as follows:

REC: Annual gross receipts in thousands of dollars.

REC^2: Square of annual receipts.

URB: Dummy variable which equals one if the firm is located in a metropolitan area of 50,000 or more but not in a suburb; zero otherwise.

GHT: Dummy variable which equals one if the firm is located in a ghetto in a city of 50,000 or more; zero otherwise.

III. EMPIRICAL ANALYSIS OF THE DEMAND FOR PROTECTION

Since dummy dependent variables are used to test equation (11) a dichotomous logit function must be employed.[33] The logit model, which is estimated by the method of maximum likelihood, specifies the probability that the firm hires a guard as:

$$P_{G_i} = \frac{1}{1 + e^{-\alpha - \beta X_i}} \tag{21}$$

where X_i is a vector of exogenous variables. Tables 3 and 4 contain the results of the maximum likelihood estimation of equation (21) using GD

[33] A linear probability function cannot be employed because the usual tests of a significance of the estimated coefficients cannot be used; predicted values of some observations may lie outside the zero to one range since a linear function is unbounded, and the residuals are not homoskedastic. The logit function avoids these problems.

and PSER as the dependent variables. Analyzing these two tables simultaneously facilitates a comparison of the factors that determine the hiring of a security guard and the subscription to a protective service. Insurance variables are excluded from the regression in Tables 3 and 4; since their inclusion in the equation did not affect the other variables the effect of insurance on the demand for protection is discussed later.

A. Endowed Loss, Endowment Probability, and the Effect of Protective Devices on the Probability of a Loss

1. Endowed loss

In Tables 3 and 4 the firm's endowed loss is estimated by LOSS, the mean loss of other firms as described in Part II. Regressions 3.1, 3.2, 3.4 and 4.1, 4.2, 4.4 use the industry grouping method. $LOSS^i$ has a positive and significant[34] effect in all the equations. When size of firm and location are not held constant, an increase of $1,000 in the endowed loss makes the firm 32 per cent more likely to hire a guard and 26 per cent more likely to subscribe to a protective service.[35] When size and location are held constant the partial effect of $LOSS^i$ is reduced because size and location are used in the construction of the

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[34]The significance level in regressions 3.2 and 3.4 is 12 per cent.

[35]These effects are computed by using the mean probability of hiring a guard which is .059 and the mean probability of subscribing to a protective service which is .069.

TABLE 3

Maximum Likelihood LOGIT Regressions
Dependent Variable GD (N = 1876)
(Asymptotic t-ratios in parentheses)

	3.1	3.2	3.3	3.4
$LOSS^i$	.1887D-04 (4.11)	.8446D-05 (1.53)		.8390D-05 (1.52)
$PROB^i$	.1296 (3.84)	.8986D-01 (2.44)		.8986D-01 (2.44)
$LOSS^r$			.7661D-05 (1.39)	
$PROB^r$			.1862 (4.25)	
AVG^i	.1527D-03 (4.24)	.9750D-04 (2.37)		.9736D-04 (2.36)
AVG^r			.9723D-04 (1.46)	
GDI	-.2807D-04 (-2.13)	-.2577D-04 (-1.91)	-.3908D-04 (-2.94)	-.2574D-04 (-1.91)
EDUC	.6290D-02 (.45)	.8568D-02 (.60)	-.7549D-02 (-.52)	.7018D-02 (.47)
PUB	-.3773D-03 (-.33)	-.9956D-03 (-.86)	.1061D-03 (.09)	-.1120D-02 (-.92)
YRS	.3619D-03 (1.05)	.3084D-03 (.86)	.3548D-03 (1.03)	.3247D-03 (.90)
STK	.3503D-04 (3.52)	.3445D-04 (3.45)	.3416D-04 (3.60)	.3440D-04 (3.45)
PCT	-.3084D-01 (-.21)	-.2176D-01 (-.15)	-.7476D-01 (-.51)	-.2010D-01 (-.14)
REC		.2343D-04 (3.27)		.2340D-04 (3.27)
REC^2		-.1249D-08 (-2.57)		-.1247D-08 (-2.57)
URB		.3222D-01 (2.34)		.2920D-01 (1.78)
GHT		.1245D-01 (.49)		.1204D-01 (.47)
CRIME				.4851D-05 (.34)
x^2	104.74	124.04	91.64	124.16

TABLE 4
Maximum Likelihood LOGIT Regressions
Dependent Variable PSER (N = 1896)
(Asymptotic t-ratios in parentheses)

	4.1	4.2	4.3	4.4
$LOSS^i$	.1794D-04 (3.26)	.1080D-04 (1.67)		.1068D-04 (1.65)
$PROB^i$	.2143 (5.46)	.1870 (4.52)		.1862 (4.51)
$LOSS^r$			.7108D-05 (1.19)	
$PROB^r$			.2527 (5.03)	
AVG^i	.2037D-03 (5.14)	.1580D-03 (3.51)		.1542D-03 (3.38)
AVG^r			.1109D-03 (1.50)	
GDI	-.1396D-04 (-.93)	-.1559D-04 (-1.02)	-.2643D-04 (-1.74)	-.1711D-04 (-1.13)
EDUC	.2176D-01 (1.41)	.2286D-01 (1.46)	.2729D-02 (.17)	.1103D-01 (.67)
PUB	-.1705D-03 (-.14)	-.7650D-03 (-.61)	.7178D-03 (.58)	-.1778D-02 (-1.32)
YRS	-.7671D-03 (-1.58)	-.8117D-03 (-1.63)	-.7262D-03 (-1.50)	-.6944D-03 (-1.39)
STK	.6617D-04 (5.31)	.6399D-04 (5.27)	.6464D-04 (5.24)	.6431D-04 (5.45)
PCT	-.1228D-01 (-.07)	-.1298D-01 (-.08)	-.8258D-01 (-.49)	-.2957D-02 (-.02)
REC		.2097D-04 (2.36)		.2129D-04 (2.40)
REC^2		-.1405D-08 (-2.27)		-.1431D-08 (-2.31)
URB		.2568D-01 (1.65)		.3943D-02 (.22)
GHT		.5220D-01 (2.22)		.5021D-01 (2.14)
CRIME				.3570D-04 (2.29)
X^2	177.58	190.52	150.32	195.76

endowed loss variable. From regressions 3.2 and 4.2, a \$1,000 increase in the endowed loss results in the firm being 14 per cent more likely to hire a guard and 16 per cent more likely to subscribe to a protective service. When the endowed loss is estimated via the regional method in regressions 3.3 and 4.3 its effect is, as predicted, much smaller than that of the industry loss and, moreover, the effect is not significant. An increase of \$1,000 in the regional endowed loss, not holding size and location constant, makes the firm only 13 per cent more likely to hire a guard and 10 per cent more likely to subscribe to a protective service; these effects are about two-fifths the size of the industry loss effects.

2. Endowment probability

In Tables 3 and 4 the firm's endowment probability is estimated by PROB, the incidence of crime among "similar" firms. As shown in (19) the coefficients on PROB overestimate the true effects of the endowment probability. Choosing values for γ within the acceptable range $0 < 1 + \gamma \text{ AVG} < 1$ enables one to compute the true effects. The largest acceptable value for γ under the industry grouping method is $|-.001|$ while for the regional method it is $|-.0022|$. For comparative purposes, the value -.001 is used to compute all the estimated effects of the endowment probability.

When size and location are not held constant an increase of ten percentage points in the industry p^e ($PROB^i$) makes the firm 20 per cent more likely to hire a guard and 29 per cent more likely to subscribe to a protective service. Holding size and location constant the effects are reduced to 14 per cent and 25 per cent, respectively. All of these coefficients are significant. Using the regional method to measure the endowment probability, with size and location not held constant, we find that an increase of ten percentage points in p^e makes the firm 29 per cent more likely to hire a guard and 34 per cent more likely to subscribe to a protective service. As predicted in Part II the regional probability is a better measure of p^e than the industry probability but both still have significant effects on the firm's protection decisions. Unlike the results for the endowed loss, both industry and region are important determinants of the firm's endowment probability.

3. Effect of protective devices on reducing the probability of a loss

As predicted by equation (18) in Part II, the coefficients on AVG have positive and significant effects on the probability that the firm hires a guard and on the probability that it subscribes to a protective service. The ratio of the coefficient on AVG to the coefficient on PROB is an estimate of λ which is that portion of the effect of protection expenditures on the probability of a loss,measured across cells, that is independent of p^e [see equation (15) in Part II]. Table 5 shows the estimates of λ from Tables 3 and 4, the estimates of β, and the full effect of protection on the probability of a loss when $\gamma = -.001$ and p^e is computed as in equation (16). It should be emphasized that β reflects the reduction in p due to expenditures on protective devices.

From Table 5 we find, using the industry method, that if a firm that has already made outlays of \$79 on protective devices (the mean AVG^i) spends one more dollar on a device it can reduce its probability of a loss by approximately .0015. Ignoring diminishing marginal productivity, an expenditure of \$100 would reduce the probability by fifteen percentage points. With the regional method, however, an expenditure of \$100 is estimated to reduce the probability of a loss by only ten percentage points. The regional effects are smaller because of the strong positive correlation (ρ = .61) between $PROB^i$ and AVG^i. While the theory predicts that an increase in protection expenditures reduces the probability of a loss, i.e. λ is negative, I have measured λ across regional groups, and across groups the higher the probability the higher will be protection expenditures in that group. This is similar to the problem of estimating the effect of public protection expenditures on crime rates in a cross-section of states. While protection expenditures reduce crime, if crime is high expenditures will be high, thus resulting in a positive correlation. A positive bias therefore exists in the estimation of λ with the regional method. Since the correlation between $PROB^i$ and AVG^i is only .28 larger absolute values for λ are estimated with the industry method.

4. Elasticity of L^e vs. elasticity of p^e

Table 6 summarizes the elasticities of GD and PSER with respect to the endowed loss and the endowment probability which are measured by the loss experience of other firms. The probability elasticity is computed

TABLE 5

Estimated Effects of Protective Devices on Reducing the Probability of a Loss

Regression	λ	$\beta = \lambda - .001\, p^e$
Industry Method		
10.1	-.0012	-.0017
10.2	-.0011	-.0016
11.1	-.0010	-.0015
11.2	-.0008	-.0013
Regional Method		
10.3	-.0005	-.0010
11.3	-.0004	-.0009

TABLE 6

Loss and Probability Elasticities

Regression	ϵL^e	ϵp^e	t-value on $(\epsilon p^e - \epsilon L^e)$
10.1	.23	1.07	2.75
10.2	.10	.73	1.98
10.3	.09	1.38	3.91
11.1	.19	1.48	4.77
11.2	.11	1.27	4.07
11.3	.08	1.60	4.75

at the mean p^e.[36] In all the regressions εp^e is significantly larger than εL^e. As indicated in Part I (see footnote 19) this result can be consistent with our original assumption that firms act as if they are risk neutral or risk averse.

5. The firm's own loss experience

In Table 7 the estimates of the endowed loss and the endowment probability are modified to consider the influence of the firm's own loss experience in the previous twelve months. While RELDEV is statistically significant in both regressions 7.1 and 7.3 its economic significance is minimal. If a firm had a loss that was 50 per cent above the mean loss of the group then it is only about 5 per cent more likely to hire a guard and 6 per cent more likely to subscribe to a protective service. These small effects could be due to one or both of the following: (1) Simultaneity exists since a firm that currently has a guard (protective service) may also have had him last year and this firm would therefore be very likely to have reported zero or very low losses for the year. (2) The firm does not consider the value of its own loss a good estimate of the value of future losses. By averaging the losses incurred by similar firms

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[36] $\varepsilon GD, p^e = \frac{b_1}{\overline{GD}} \overline{p}^e = \frac{b_1}{\overline{GD}} \frac{\overline{PROB} - \lambda \overline{AVG}}{1 + \gamma \overline{AVG}}$. The observed coefficient on PROB is $\frac{b_1}{1 + \gamma \overline{AVG}}$ so in order not to understate the elasticity the quantity $-\lambda \overline{AVG}$ must be added to $\overline{PROB}$.

TABLE 7
LOGIT Regressions Analyzing the Effects of the Firm's Own Loss History
(Asymptotic t-ratios in parentheses)

	GD		PSER	
	7.1	7.2	7.3	7.4
$LOSS^i$	.8314D-05 (1.50)	.7957D-05 (1.50)	.1047D-04 (1.61)	.1030D-04 (1.57)
$PROB^i$	.8269D-01 (2.22)	.3677D-01 (1.00)	.1752 (4.19)	.1283 (2.92)
RELDEV	.6368D-02 (1.85)	.1887D-02 (.48)	.8097D-02 (2.39)	.4062D-02 (1.11)
POSLOS		.4943D-01 (3.55)		.5295D-01 (3.43)
AVG^i	.9851D-04 (2.40)	.1035D-03 (2.52)	.1575D-03 (3.50)	.1574D-03 (3.47)
GDI	-.2588D-04 (-1.91)	-.2923D-04 (-2.14)	-.1545D-04 (-1.01)	-.1944D-04 (-1.26)
EDUC	.7869D-02 (.55)	.4722D-02 (.33)	.2355D-01 (1.50)	.1829D-01 (1.15)
PUB	-.9472D-03 (-.82)	-.8663D-03 (-.74)	-.8081D-03 (-.64)	-.5305D-03 (-.42)
YRS	.3363D-03 (.94)	.2366D-03 (.66)	-.7495D-03 (-1.51)	-.8901D-03 (-1.77)
STK	.3294D-04 (3.28)	.3200D-04 (3.22)	.6271D-04 (5.18)	.6227D-04 (5.21)
PCT	-.2645D-01 (-.18)	-.3402D-01 (-.23)	-.5092D-02 (-.03)	-.2348D-01 (-.14)
REC	.2341D-04 (3.26)	.2465D-04 (3.33)	.2123D-04 (2.37)	.2298D-04 (2.49)
REC^2	-.1237D-08 (-2.54)	-.1308D-08 (-2.62)	-.1395D-08 (-2.25)	-.1490D-08 (-2.33)
URB	.3303D-01 (2.40)	.3479D-01 (2.51)	.2732D-01 (1.75)	.2902D-01 (1.85)
GHT	.8467D-02 (.33)	-.7178D-03 (-.03)	.4902D-01 (2.39)	.3851D-01 (1.61)
X^2	126.95	139.86	195.49	207.62
N	1876	1876	1896	1896

this particular firm obtains a less stochastic estimate of its endowed loss.

One way to test these alternative hypotheses is to include the dummy variable POSLOS in the estimate of the endowment probability as is done in regressions 7.2 and 7.4. These regressions indicate that if a firm had a loss last year it is 88 per cent more likely to hire a guard now and 84 per cent more likely to currently subscribe to a protective service.[37] Obviously even if simultaneity is present it does not affect the strong positive influence of the firm's having been victimized. But the dollar loss that the firm incurred has no effect in regressions 7.2 and 7.4 since RELDEV is not significant there. This indicates that the absolute value of the loss incurred last year is not a good estimate of the firm's future loss but the mere occurrence of the crime is an important determinant of the firm's endowment probability.[38]

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[37] Since we have $GD = a + b_1 \text{ POSLOS} + b_2 \dfrac{(\text{POSLOS}^* \text{ L} - \text{LOSS}^i)}{\text{LOSS}^i} + \ldots$ where L is the dollar loss for those firms with a loss, the full effect of POSLOS is $b_1 + \dfrac{b_2 \text{ L}}{\text{LOSS}^i}$.

[38] In regression 7.2, PROB^i is no longer significant. This could be due to its correlation with POSLOS which is .4. However in regression 7.4, PROB^i is still quite significant. Since RELDEV is not significant in regressions 7.2 and 7.4 and RELDEV is a function of LOSS^i, the effects of LOSS^i in these regressions are not significant. Because RELDEV adds nothing to the regressions, however, the true effects of LOSS^i should not be reduced by adding an insignificant coefficient.

B. Public Expenditures and Crime Rates

1. Public expenditures

The true effect of public protection expenditures on the demand for private guards and protective services can only be measured if the crime rate is held constant as is done in regressions 3.4 and 4.4. These regressions indicate a public expenditure elasticity of -.32 for GD and -.43 for PSER. The relatively larger and more significant effect for PSER can be explained by the different nature of the tasks that the two types of security personnel perform. A guard can work as a night watchman and thereby reduce the probability of burglary and vandalism. Or he may be assigned to work inside the store or plant in order to protect against shoplifting and employee theft. In the latter role his substitutability with public policemen is almost nil since he performs a task that could not possibly be performed by the policeman on the beat. A protective service, however, acts in a very similar capacity to that of public policemen since it patrols outside the store, and therefore its primary responsibility is to reduce the occurrence of burglary and/or vandalism.

However, even though CRIME is held constant, PUB is not really significant in either regression 3.4 or 4.4.[39] A possible explanation of these coefficients could be that the level of per capita public

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[39] I have also used the number of policemen per capita to measure public protection and its effects were insignificant. See Bartel (1974).

expenditures or the number of policemen per capita does not correctly measure the amount of public protection the firm receives. This problem was documented in a recent study of the police forces in several large cities.[40] For example, the study found that although the New York City police force increased by 20,000 men over the last two decades, or from 1.39 policemen per 1,000 inhabitants to 3.92 policemen per 1,000 inhabitants, the number of police officers actually out on patrol remained constant over the same period. Similar disparities were reported in other large cities. To the extent that time series coefficients and cross-sectional coefficients are comparable, this phenomenon can explain why a firm will not necessarily reduce its level of private protection when public expenditures increase.

2. Crime rates

The coefficients on CRIME are noticeably different in regressions 3.4 and 4.4. CRIME has no effect on the probability that the firm will hire a guard but it has a positive and significant effect on the probability that it will subscribe to a protective service. There are two reasons for these diverse coefficients. First, since only a fraction of the total property crime rate (about 43 per cent of burglary,

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[40] See David Burnham, "1,000 of the City's 31,000 Policemen Are Out in Radio Cars at Any One Time," The New York Times, February 18, 1974 for a description of the survey's findings.

25 per cent of robbery, 10 per cent of larceny)[41] refers to crimes against business, firms would not use CRIME as a very reliable measure of their own endowment probability.[42] A firm would not be willing to commit itself to the employment of a full-time guard based on imperfect information but it may be more willing to make a small outlay in the form of a subscription to a protective service. Second, since CRIME primarily measures crimes against non-businesses, household demand for protection will rise when CRIME rises. One type of protection households could seek is that provided by a protective service and a substantial household demand for this service could facilitate a firm's subscription to it. If a private patrol car will be dispatched to police a neighborhood only if there are a certain number of subscribers in that neighborhood then an increase in crime against both residences and businesses would enable them to agree on the hiring of a protective service for their neighborhood.

C. Size of Firm

Evaluating the effect of REC at its mean value, we find from regressions 3.2 and 4.2 that a firm with gross sales of approximately $1.5

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[41] These percentages are based on information contained in Table 18 of the 1967 Uniform Crime Reports. This residence/business breakdown was only done for 673 cities with a population of at least 25,000 but the figures can serve as general guidelines for the U.S. as a whole.

[42] In fact, the elasticity of PSER with respect to CRIME is only .66 while the elasticity with respect to $PROB^i$ (evaluated at p^e) in regression 4.4 is 1.26.

million would be 38 per cent more likely to hire a guard than one with gross sales of $1/2 million but it would only be 28 per cent more likely to subscribe to a protective service. Even though LOSS and PROB are held constant in the regression and REC is used to construct these variables, REC still has a positive effect because REC is only stratified into three groups to compute LOSS and PROB. The coefficient on REC reflects the complete size variation and thus the influence of size on dollar losses. The theoretical model predicted, however, that small firms would be more likely to subscribe to protective services since they expect a smaller loss (everything else held constant) and would not require their own guard. Although REC has a positive and significant effect on PSER, the effect is 35 per cent smaller than the effect of REC on the demand for guards; this would be consistent with the theoretical prediction.

D. Location of Firm

The effect of being in an urban area and/or in a ghetto can be analyzed as follows: Since ghetto firms must be in urban areas, the ghetto dummy is actually an interaction term, i.e.

$$P_{Gi} = a + b_1 \text{ URB} + b_2 \text{ URB} * \text{GHT} + \ldots. \qquad (22)$$

Then the effect of being in an urban area is

$$\frac{\partial P_{Gi}}{\partial \text{URB}} = b_1 + b_2 \text{ GHT} \qquad (23)$$

and the effect of being in a ghetto is

$$\frac{\partial P_{Gi}}{\partial GHT} = b_2 \, URB \qquad (24)$$

Therefore, b_1 measures the effect of being in an urban nonghetto area versus a nonurban area; b_2 measures the effect of being in a ghetto versus an urban nonghetto area; and $(b_1 + b_2)$ is the effect of being in a ghetto versus a nonurban area. From regressions 3.4 and 4.4 where CRIME is held constant we find that (1) ghetto firms are more likely to hire both guards and protective services than are nonurban firms; (2) ghetto firms are more likely to subscribe to protective services than are urban nonghetto firms but they are not more likely to hire guards; and (3) urban nonghetto firms are more likely to hire guards than are nonurban firms but they are not more likely to subscribe to protective services.

Ghetto firms are more likely to hire both guards and protective services than are nonurban firms because they face higher endowment probabilities and higher endowed losses from crime. This effect is not picked up in the $LOSS^i$ and $PROB^i$ coefficients because $LOSS^i$ and $PROB^i$ only distinguish between urban and nonurban firms without any special provision for ghetto firms; and ghetto firms have significantly higher endowment probabilities than urban nonghetto firms.[43] The

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[43]From Table 10, regression 10.3, we see that ghetto firms are 73 per cent more likely to incur a loss than urban nonghetto firms. However when the same equation is run just on those firms with a loss and the dollar value of the loss is used as the dependent variable, GHT is not significant.

magnitude of $(b_1 + b_2)$ is about the same in both equations; ghetto firms are 70 per cent more likely to hire guards and 78 per cent more likely to subscribe to protective services than are nonurban firms.

The fact that ghetto firms are more likely to subscribe to protective services but not more likely to hire guards than are urban nonghetto firms is due to the size distribution of surrounding firms. Ghetto firms are more homogenous in size than urban nonghetto firms.[44] A small ghetto firm has many other small firms in its neighborhood that also need protection but whose size precludes them from hiring their own guard; these firms would be anxious to subscribe to a protective service that could patrol the entire area. The small urban nonghetto firm, on the other hand, does not necessarily have many other small firms nearby with whom it could hire a protective service; it is not unusual, for example, for a small retailer to be located on the same block with many large department stores that hire their own full-time guards.

The reason that urban nonghetto firms are more likely to hire guards but not more likely to hire protective services than are nonurban firms relates to the urban nonghetto firm's higher probability of employee

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[44]The standard deviation of REC for ghetto firms is 339,380 and the coefficient of variation is 2.1. The standard deviation for urban nonghetto firms is 2,753,558 and the coefficient of variation is 3.

theft.[45] When CRIME is not held constant (see regressions 3.2 and 4.2), URB is significant for both forms of protection; obviously $LOSS^i$ and $PROB^i$ do not completely capture the urban firm's vulnerability to crime. The addition of CRIME provides more information on the urban firm's probability of external theft (i.e. burglary, vandalism, robbery) and thereby weakens the urban dummy in both regressions 3.4 and 4.4. However, CRIME does not measure employee theft and PROB measures the probability of <u>any</u> crime, not specifically employee theft. URB therefore captures the higher incidence of employee theft among urban nonghetto firms than nonurban firms and the demand for guards among urban nonghetto firms will rise; since protective services do not affect employee theft URB is insignificant in regression 4.4.

E. <u>Other Independent Variables in Tables 3 and 4</u>

GDI is negative and significant in all the regressions in Table 3 because of the own price effect. While it is negative in all the regressions in Table 4 it is not significant there and this is probably due to the Census category, "guards and watchmen," which was used. Protective services are more properly classified as private patrolmen but in the Census the wage rates of private patrolmen are

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[45] The observed probability of employee theft among urban nonghetto firms is .081 while for nonurban firms it is .056. These numbers are significantly different from one another at the 10 per cent level of significance.

indistinguishable from those of public patrolmen.[46] The inappropriateness of GDI for protective services would therefore account for the insignificant coefficients.

EDUC is never significant in any of the regressions in Tables 3 and 4. This implies that education does not increase the productivity of guards and protective services. An alternative explanation of the insignificant coefficient is that since EDUC is highly correlated with the deflator used for GDI ($\rho = .7$) the deflator could in part be picking up the positive effect of EDUC.[47] The problem arises from the fact that the deflator is a wage, not a price index, and it therefore picks up productivity effects due to education; across states the education of manufacturing workers would be highly correlated with the education of guards.

STK is positive and significant in all regressions. This cannot be interpreted as evidence of complimentarity between protective devices and security personnel since the output of these factors of production (they produce 1-p) is not being held constant; PROB only

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[46]While the guards and watchmen category also contains public guards, 68 per cent of the category are private guards, and, in fact, many "public" guards can really be treated as private security workers since they do not have public peace officer powers. In the policemen category, however, 96 per cent of the workers are public policemen.

[47]When the wage rate of guards is not deflated by the index, EDUC is significant. See Appendix D in Bartel (1974). However, this is not the correct way to measure the price of guards and one can therefore not rely on the EDUC coefficient from this regression. A state price index is required for the proper estimation of these coefficients.

holds the endowment probability constant. The positive sign may merely reflect a scale effect, i.e. a movement from isoquant to isoquant rather than a movement along a given isoquant.

Holding CRIME, URB, and GHT constant in regressions 3.4 and 4.4, YRS has a positive but insignificant effect on the demand for guards and a negative and almost significant effect on the demand for protective services. This indicates that an increase in the experience of the entrepreneur raises his "output" productivity more than his "protection" productivity, and he reduces his time spent in protection. He is then somewhat more likely to hire a guard but less likely to hire a protective service because guards and entrepreneurial policing time are, on balance, substitutes, while protective services and entrepreneurial time, are, on balance, complements (see footnote 17). The substitutability between guards and the entrepreneur occurs because they both operate inside the store (e.g. policing customers and employees) or on the immediate grounds (e.g. checking gates to thwart burglars or vandals). A protective service acts as a complement to the entrepreneur's policing time because (1) by patrolling outside during the day it frees the entrepreneur to more effectively police his employees and customers inside and (2) since private patrol cars also respond to alarms (triggered by burglars) that ring either inside the car or at the dispatch center the entrepreneur's time is required to maintain the efficiency of the alarm system (i.e. he must periodically check to see if it is working).

F. The Relationship Between Protection and Insurance

Table 8 contains coefficients for the two insurance variables, ANYINS and AMTBINS, each of which was added to the GD and PSER regressions. Both coefficients on the dummy variable ANYINS are positive and significant. Firms with insurance are 60 per cent more likely to hire guards and 53 per cent more likely to subscribe to protective services.

TABLE 8

Insurance Coefficients
(t-ratios in parentheses)

	GD	PSER
ANYINS	.3569D-01 (2.37)	.3625D-01 (2.19)
AMTBINS	.3217D-04 (.71)	-.1016D-04 (-.38)

This is a clear rebuttal of the moral hazard argument; of course the causality could be in the opposite direction since a firm may have hired a guard (protective service) in order to be able to purchase insurance.

When the continuous variable, AMTBINS, is used, insurance has no effect on GD and PSER. The relationship between protection and the price of insurance that was the basis for the positive signs on ANYINS no longer exists because AMTBINS refers to last year's insurance. The more the firm was reimbursed last year the lower its expected net loss this year[48] and hence the smaller its demand for guards and protective services. The absence of significantly negative coefficients on AMTBINS is probably due to serial correlation in the dependent variable (see discussion on page 35).

Table 9 contains coefficients for ANYINS which were obtained from separate regressions run on urban and nonurban firms. For both dependent variables, the positive effect of insurance is much larger for nonurban firms than for urban firms. Nonurban firms with insurance are 82 per cent more likely to hire guards than nonurban firms without insurance while urban firms with insurance are only 33 per cent more likely to hire guards than urban firms without insurance. Similarly, nonurban firms with insurance are 69 per cent more likely to subscribe to protective services than nonurban firms without insurance while urban firms with insurance are only 28 per cent more likely to subscribe to protective services than urban firms without insurance.

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[48] Note that a dummy variable for the presence of burglary insurance is included in these two regressions so that AMTBINS is a proxy for the firm's burglary insurance reimbursement this year.

TABLE 9

Effects of Insurance for Urban and Nonurban Firms

	Urban		Nonurban	
	Coefficient (t-ratio)	Relative Effect	Coefficient (t-ratio)	Relative Effect
GD	.3536D-01 (1.00)	33%	.2951D-01 (2.04)	82%
PSER	.3622D-01 (.94)	28%	.2779D-01 (1.82)	69%

These differential effects for urban and nonurban firms can be explained by the fact that urban insurance would tend to be less fair than insurance in nonurban areas. This is because the higher incidence of crime in urban areas would make the provision of insurance more costly, i.e. processing and administrative costs would increase as the probability of crime increased. The more fair the insurance is, the stronger the complementary relationship between insurance and protection because the firm is able to get a larger benefit (in terms of a premium reduction) from the reduction in the probability of a loss. When insurance is actuarially fair, the firm gets the full benefit from protection.

IV. AN ANALYSIS OF THE INCIDENCE OF CRIME AGAINST BUSINESS

This article has been concerned with analyzing the determinants of the demand for private protection manpower. The Small Business Administration data also make it possible, however, to analyze the factors that determine which firms will incur a loss from crime in a twelve-month period. In order to conduct such an analysis several new variables are defined as follows:

SOUTH: Dummy variable which equals one if the firm is located in the South; zero otherwise.

NW: Dummy variable which equals one if the firm is owned or managed by a black; zero otherwise.[49]

YRSGHT: Interaction term = YRS * GHT.

YRSURB: Interaction term = YRS * URB.

A. Determinants of the Incidence of Crime

Table 10 contains LOGIT regressions on the dummy dependent variable POSLOS. The firm's total expenditures on protective devices, STK, are held constant so that the regression can measure the partial effects of the exogenous variables on the probability of victimization. It is possible, however, that STK may contain some recent expenditures for devices that were not present on the date that the crime occurred and the firm may, in fact, have purchased the devices in response to this

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[49] 2.3 per cent of the respondents to the SBA questionnaire were black. 89 per cent of this group were the owners of the firms and only 11 per cent were managers. Therefore NW basically measures black ownership.

TABLE 10

LOGIT Regressions on the Probability of Victimization
Dependent Variable is POSLOS
(Asymptotic t-ratios in parentheses) N = 1941

	10.1	10.2	10.3	10.4
REC	.8388D-04 (3.87)	.7770D-04 (3.60)	.8323D-04 (3.83)	.8346D-01 (3.85)
REC^2	-.5252D-08 (-3.42)	-.4944D-08 (-3.22)	-.5206D-08 (-3.38)	-.5189D-08 (-3.38)
URB	.8698D-01 (3.36)	.1173 (4.72)	.6608D-01 (2.20)	.8885D-01 (2.30)
GHT	.2937 (4.24)		.2904 (4.20)	.1917 (1.92)
SOUTH	-.5853D-01 (-2.27)	-.6168D-01 (-2.40)	-.6019D-01 (-2.33)	-.6136D-01 (-2.37)
NW	.4393D-01 (.54)	.1114 (1.47)	.4497D-01 (.56)	.5301D-01 (.66)
PUB	.2667D-04 (.02)	.1344D-04 (.01)	-.1407D-02 (-.68)	-.1308D-02 (-.63)
CRIME			.3300D-04 (1.40)	.3232D-04 (1.33)
STK	.9154D-04 (2.40)	.1023D-03 (2.66)	.8980D-04 (2.37)	.9013D-04 (2.36)
YRS	.2947D-02 (3.75)	.3032D-02 (3.87)	.3092D-02 (3.90)	.3420D-02 (3.57)
YRSURB				-.1617D-02 (-.94)
YRSGHT				.7193D-02 (1.27)
X^2	110.92	90.74	112.77	115.01

crime; this would result in a simultaneous relationship. Since STK does include past expenditures it is a better control for the level of protection in the previous twelve-month period than is GD or PSER since we cannot be sure that a firm which had a guard on the interview date also had him twelve months ago; simultaneity would be a more severe problem with the latter variables.

1. Size of firm

Even when protection expenditures and location are held constant, large firms are more likely to incur losses than are small firms. The elasticity, however, is only .10; a firm with gross sales of $1 million is 10 per cent more likely to incur a loss than a firm with gross sales of $1/2 million. This sales effect could be due to one or more of the following: (1) the entrepreneur's efficiency in policing his firm declines as firm size increases; (2) small firms may be less likely to report a loss for fear of being branded a poor credit risk; large firms often have internal sources of funds and they would therefore have less to lose from the reporting of a crime; (3) criminals find larger firms to be more attractive targets.

2. Location and region

Urban nonghetto firms are 21 per cent more likely to be victimized than are nonurban firms while ghetto firms are 94 per cent more likely to incur a loss than are nonurban firms. Moreover, ghetto firms are 73 per cent more likely to incur a loss than are urban nonghetto firms.

The regional dummy, SOUTH, has a negative and significant effect; Southern firms are 14 per cent less likely to be victimized than firms in other regions. This is because the South has a smaller supply of property criminals than the other regions since illegal opportunities are lower in the South.[50] Even though CRIME is held constant the significance of SOUTH indicates that CRIME is an underestimate of the true rate of criminal offenses[51] or at least of the true rate of offenses against firms.

3. Race of owner

The racial characteristics of the firm may affect its probability of property crime victimization. Since blacks have lower legal opportunities than whites the proportion of property offenders among the black population should be greater than the proportion among whites. Also firms owned by blacks tend to be located in areas that are predominantly

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[50]Median family income in the South is $8,079 while in the non-South it is $10,200. (Source: U.S. Department of Commerce, Bureau of the Census, General Social and Economic Characteristics, 1970 Census of Population, Table 135). I. Ehrlich (1973) has used this variable as a measure of illegal payoffs in order to predict the rate of crime across states.

[51]The fact that the Uniform Crime Reports data understate the true crime rate has been documented by surveys currently being carried out by the Law Enforcement Assistance Administration. See David Burnham, "Federal Surveys to Gauge Crime Levels in Big Cities," The New York Times, January 27, 1974, p. 1 for a description of these surveys. Preliminary results from the surveys indicate that the true crime rate is at least twice that of the rate reported in the Uniform Crime Reports.

black. Therefore, these firms would be close to a greater supply of criminal offenders than firms owned by whites. The dummy variable for ownership by a black, NW, is not significant, however, when GHT is held constant. This is because GHT measures the firm's proximity to a greater supply of criminal offenders. When GHT is dropped from the equation, as in regression 10.2, nonwhite firms are 27 per cent more likely to be victimized than are white firms.

4. Public expenditures and crime rates

Even when CRIME is held constant PUB has no effect on whether or not the firm is victimized. In Part III, although the coefficients were not significant, PUB had a negative effect on the demand for guards and protective services with an elasticity ranging from -.32 to -.43. This effect was said to be due to either a reduction in the firm's probability of victimization and/or a reduction in the marginal product of private security manpower. Since PUB has no effect on POSLOS in Table 10 this implies that the negative coefficients in Part III were due to the marginal product effect.

CRIME has a positive effect (significance level is 17 per cent) on the firm's probability of victimization. In areas where the overall crime rate is high a firm is more likely to be victimized because it faces a greater supply of criminal offenders.

5. Protection expenditures

STK was used in the regression as a control for the amount of protection the firm had when the loss took place. STK should have a negative sign since, everything else constant, an increase in protection results in a decrease in the probability of victimization. In all the regressions in Table 10, however, STK has a positive coefficient. This is due to simultaneity; after the firm incurred a loss it added to its stock of protection. Part of the simultaneity, however, is indirect.[52]

6. Years at present location

In regressions 10.1, 10.2, and 10.3, YRS has a positive and significant effect. One possible explanation is that firms that have been at their present location for a long time tend to be located in high-crime areas. The true effect of YRS would be dependent upon the firm's being located in an urban area or a ghetto and the regresssion requires interaction terms between YRS and URB and between YRS and GHT, i.e.

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[52]In Part III we saw that STK had a positive and significant effect on both GD and PSER. Moreover, POSLOS also had a positive and significant effect, i.e. firms that incurred a loss during the previous twelve months were more likely to have guards and/or protective services at the time of the interview. To show that the positive and significant coefficients on STK in Table 10 are due to the above relationships, I added a dummy variable, GDSER, which equals one if the firm has a guard or protective service,to the regression. The result was that the coefficient on STK was reduced by 42 per cent and was no longer significant. See Bartel (1974), Table 25.

$$POSLOS = a + b_1 \text{ YRS} + b_2 \text{ URB} + b_3 \text{ GHT} + b_4 \text{ YRSURB} + b_5 \text{ YRSGHT} + \ldots \qquad (25)$$

The true effect of YRS can be written as:

$$\frac{\partial \text{ POSLOS}}{\partial \text{ YRS}} = b_1 + b_4 \text{ URB} + b_5 \text{ GHT} \qquad (26)$$

According to this hypothesis, b_1 should be insignificant and b_4 and b_5 should be positive and significant; YRS would be a proxy for the undesirableness of a neighborhood given that the firm is in an urban (and ghetto) area. This hypothesis is tested in regression 10.4. The coefficient on YRS is still significant while the coefficients on YRSURB and YRSGHT are not significant. Even if a firm is in a nonurban area the longer it has been at its present location the more likely it is to have been victimized. The fact that "old" firms are more likely to be victimized than "young" firms is unrelated to the location of the firm.[53]

The most reasonable explanation of the YRS coefficient is one or both of the following. One, firms that have been at their present location for longer periods of time are in old buildings that are most vulnerable to

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[53] Moreover, even if we look just at the set of nonurban firms, i.e. let GHT = URB = YRSGHT = YRSURB = 0, the positive effect of YRS cannot be attributed to crime in the area, because the youngest of the nonurban firms, i.e. those in the suburbs (mean values for YRS is 10.6 years for suburban firms and 15.1 years for other nonurban firms), would have the highest crime rates since they are closest to the urban areas and a large supply of criminals.

crime. In other words, YRS measures the private protection level inherent in the physical plant, e.g. special lighting and display cases, more durable doors and windows, etc. These forms of protection would not show up in the expenditure variable, STK, since that variable only includes alarms, locks, and gates. Young firms, would, on average, be in newer buildings which would have been built with more of a concern for crime deterrence than older buildings. Two, YRS proxies the experience of the entrepreneur both in producing his output and protecting his firm. The regression results indicate that even if the entrepreneur becomes more efficient over time in self-protection, he becomes relatively more efficient in output production and therefore reduces his time spent in self-protection. This reduction is so large that it outweighs the original absolute increase in protection productivity.

B. Comparison of Incidence Results to an Analysis of Household Victimization

My analysis of the determinants of the incidence of crime among firms can be readily compared to Neil Komesar's study (1973) on the factors affecting the incidence of household burglary. Komesar's important findings were that family income has a positive but insignificant effect on victimization; nonwhite families are more likely to be victimized; distance from the center city has a negative and significant effect; a dummy for the Southern region is also negative and significant; and families whose head is older are less likely to be victimized.

These results are generally consistent with my analysis of the victimization of firms. Although gross sales had a statistically significant effect in Table 10, the elasticity was only .10 which is a relatively minor effect. NW was not significant when I held GHT constant and Komesar's significant coefficient is probably due to his inability to control for location in a ghetto. Nonurban firms, like nonurban households, are less likely to be victimized. Also, firms located in the South are less likely to be victimized as are households located in the South. Komesar's negative coefficient on age was explained by his argument that older heads are more efficient in self-protecting and that they spend more time at home (a taste effect) which is a form of self-protection. The time at home argument is of course not relevant for firms. My results for YRS are consistent with the entrepreneur, like the family head, becoming more productive in self-protection, but another factor is at work. The entrepreneur becomes relatively more productive in output production and he then reduces his time in self-protection so much that this outweighs the original increase in his protection efficiency.

CONCLUSION

Before answering the three questions posed in the introduction to this article it should be reiterated here that the analysis was able to document the fact that protection expenditures reduce the incidence of crime against firms. It was shown that if the average firm spent one more dollar on protective devices its probability of a loss would fall by .0015; a $100 expenditure would result in a drop of 15 percentage points.

The answers to our three main questions regarding the private sector's demand for protection can be stated as follows:

One, firms respond rationally to real economic forces in making their protection decisions in that they are strongly influenced by increases in both the probability of a crime and the loss incurred from that crime. Firms place relatively more weight on the probability of a loss occurring rather than on the size of the anticipated loss. This implies that if criminals were to become more efficient, i.e. more able to steal larger amounts, firms would not react as strongly to this as they would to a general increase in the number of criminal incidents.

Two, an increase in per capita public protection expenditures (or in the number of policemen per capita) will reduce the demand for private security manpower, but this negative effect is not significant. A strong negative effect is dependent upon the proper allocation of the increased public expenditures and public manpower. In the last decade much of the increased public spending has been used to hire some policemen to expand office staffs and to reduce working hours rather than to increase police patrols. To the extent that a coefficient from a cross-sectional analysis is a good predictor of a time-series coefficient, it is therefore not surprising that a strong negative impact of public spending on private guards and protective services is not estimated here.

Three, insurance is not being used as a substitute for private protection. Rather, firms are hiring guards or protective services in order to be able to purchase insurance at lower prices. Giving a firm the option to purchase insurance actually makes protection expenditures a more attractive investment. The federal crime insurance programs that are designed to supply insurance to firms in high-crime areas also reinforce this complementary relationship since they have established stringent protective device requirements for the applicants.

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