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A NOTE ON THE EFFECT OF CRIME ON PROPERTY VALUES

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Graduate School of Management
Rochester-Monroe County
Criminal Justice Pilot City Program
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ABSTRACT

The purpose of this study is to estimate effects of crime rates on the residential property values in Rochester, New York. The report focuses on a regression analysis utilizing the prices for one-family homes sold in Rochester in 1971, together with information on the characteristics of the dwelling and the property crime rate in its surrounding area. Variables that were controlled for included structure condition, lot size, land use, and access to the central city. The analysis indicates that a high property crime rate in an area significantly decreases the selling price of a home there when compared to equivalent homes in less crime-ridden areas of the city.

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Governments at all levels in the United States spend together billions of dollars on the criminal justice system.[1] Various public opinion polls have confirmed that citizens, especially those in urban areas, consider crime to be a "major" problem. Yet to make policy decisions, it is important to know in economic terms just how serious a problem people think crime is. Specifically, how much are people willing to pay to live in a neighborhood with a low crime rate? It is this question to which this paper is addressed. The technique used is to estimate what effect crimes have on property values, and to infer homeowners' preferences from these estimates. The results indicate that crime has a statistically significant negative impact on property values. Further, the magnitude seems consistent with intuitive expectations.

I. THE THEORY OF HEDONIC PRICE INDEXES

The decision to purchase a house is a complex one. The price one is willing to pay depends on the characteristics not just of the structure and the land, but also of the surrounding neighborhood. Since all of these attributes are sold together, it is impossible to infer from just one sale what incremental effect one attribute (say number of bathrooms) had on the final selling price. However, using the concept of hedonic price indexes,[2] it is possible to derive such an inference from a series of sales.

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[1]A part of that expenditure for which I am particularly grateful is that which supported this research: LEAA Grant #74-NI-02-0002.

[2]See for example, Griliches, Chapter 1 [2] or Thaler and Rosen [7].

Suppose, for example, that in a tract of houses the only difference between houses is the number of bathrooms. It is then a simple matter to fit a linear regression of selling price on number of bathrooms to determine this value of a bathroom. If the houses differ in other ways, we need only expand our regression to include additional independent variables. The regression will now be of the form

$$V = \alpha + \sum_i \beta_i X_i + u \qquad (1)$$

where V is the selling price of the home, α is a constant term, the X's are the attributes, the β's are the estimated prices associated with each attribute, and the u is an error term. Thus, if one of the X's was a dummy variable equal to unity if the house had a fireplace and zero otherwise, and if the coefficient for that term were 1500, it would imply that the existence of a fireplace adds $1500 to the value of a house.

This hedonic price index technique is widely used and has been applied to many similar problems. In a study similar to this one, Ridker and Henning [5] estimated the effect of air pollution on property values in St. Louis. In addition, the data used in this paper were collected for the purpose of studying the impact zoning has on property values, again using the same methodology.

The equation to be estimated here then will be of the form

$$V = \alpha + \sum_i \beta_i X_i + \delta C + u \qquad (2)$$

where the variables are defined as before and C is a measure of the crime rate in the neighborhood of the home. The estimate of δ will provide us with a measure of how much people dislike crime. Naturally, it is expected that δ will be negative.

II. THE DATA

The analysis of this problem is performed with data from Rochester, New York in 1971. The crime data were provided by the Rochester Police Department. I used a computer tape containing all misdemeanor and felony offenses reported to the police during the year. The data included the address of the offense. We matched these addresses using a census geo-coding program to obtain offense rates by census tract. Several different measures of the crime rate were obtained: total offenses, property crimes, crimes against persons, and property crimes committed in or around homes. All four variables are highly correlated and produced similar results. I eventually settled on property crimes on the grounds that it is probably reported most accurately. The results reported below all refer to this variable.

The rest of the data come from a recent study by Steven Maser, William Riker and Richard Rosett entitled, "The Effects of Zoning and Externalities on the Prices of Land in Monroe County, New York" [4]. The data are described in detail in that report so I will be brief here. The subset of their data which I use is a random sample of one-family homes sold in the city of Rochester during 1971. There were 398 such cases in the sample. The selling price information was collected from the deed on file in the county clerk's office. Data on the lot size, assessed value, and zoning variances were also obtained from local records. Each property was then visited for a visual inspection to determine the following:

1) land use on the parcel.
2) land use on the adjacent parcel.
3) land uses or activities within sight of the parcel.
4) unusual geographic characteristics (e.g. body of water), activities (busy street) or uses (schools) within the general area.
5) condition of the structure (maintenance) both in an absolute scale and in comparison with neighboring structures.

6) code for corner property.

7) code for new structures.

8) census tract and block number.

Census data by block were used to measure neighborhood characteristics. A New York State Department of Transportation study yielded information on travel time to the central city. Finally, data were obtained to identify all houses inside a 100 decibel ground noise contour surrounding the Monroe County Airport.

III. THE ESTIMATES

Since my analysis is just an extension of the work done by Maser, Riker, and Rosett (MRR), I will briefly explain their procedure. The dependent variable in their regressions was the price per acre. Their goal was to estimate the value of the land, so they included as an independent variable the equalized assessed value of the structure. This is the value of the structure as estimated by the assessor multiplied by the ratio of the averaged assessed value to the average market value. This variable is included in lieu of a vector of structural characteristics such as square footage, number of rooms, etc., which are presumably the very factors used to determine the assessed value. The other variables used by MRR are fairly self explanatory and are, of course, defined in their report.

My first step was to rerun the MRR equation containing all of their 62 independent variables plus the additional variable property crimes per capita, C. Since the units of observation in the equation are houses, it was necessary to select an appropriate geographic area to measure the crime rate for any particular house. MRR solved this problem with their census data by using "block" statistics. I felt that a census block was too small an area to use given the magnitude of crime numbers. Many blocks would have

only a few (if any) property crimes committed within the year. Instead, I used tract data and thus each house was assigned the value of the crime rate found in the tract in which it is located.

The estimates of the coefficients and their respective t-statistics are presented in Table 1. The only coefficients showing a marked change as a result of adding the crime variable are those for percent Negro and percent Negro squared. This is discussed below. The coefficient for C is of the expected sign and is significant at the 5% level on a one tailed test.

To interpret the magnitude of the coefficient for crime, some explanation is needed. The mean for C is .0424 and its standard deviation is .0190. The estimated coefficient of -202,492 implies that an increase of one standard deviation in C will decrease the price per acre by $3847 or roughly $440 per house. This represents about 3% of the average price per home in the sample. Since I do not know of any other estimates of this parameter, it is difficult to say whether the size is larger or smaller than would be expected. It certainly seems to be in the "reasonable" category. One simple comparison can be made using the airport dummy variable from the MRR study. Recall that the airport dummy is unity when the house lies in a 100 decibel noise region. Thus, airport noise is a dichotomized variable: homes are assumed to be affected by airport noise if and only if they are situated in one of the 100 decibel regions. The estimated coefficient for this variable is -25,792. This implies that homes near the airport sell for about $2930 less than equivalent homes elsewhere. Now this figure is the difference between homes with considerable airport noise and the rest of the homes in the city which presumably have little or no airport noise. Perhaps a comparable figure for crime could be derived by composing very high crime tracts to very low crime tracts. For example, a change of 4 standard deviations would yield a change in property values of $1760 which is somewhat more than half the airport effect. I suppose this means that loud airplanes everyday are worse than a (relatively) high risk of property crime.

Another way to test the "reasonableness" of the numbers is by making some rough calculations. The crime measure we are using is property crimes per capita. The standard deviation was about .02 which can be thought of as a probability of being victimized. If we assume that households have four members, then one standard deviation is a change of .08 in the probability of a household being victimized. Now suppose that the combination of psychic costs and uninsured monetary costs for each property crime is $200. Then an increase in the probability of being victimized of .08 would be equivalent to a loss of $16 per year. At a discount rate of 10%, the net present value of $16 per year forever is $160. Our estimate of the change in property values is $440. I feel these calculations, while very rough, do indicate that we are in the right ball park.

Since many of the variables in the equation shown in Table 1 are insignificant, MRR reran the equation dropping some of these insignificant variables. I also followed this procedure. Groups of insignificant variables were dropped and the equation re-estimated. In each case, the coefficient for C remained approximately unchanged while, as would be expected, the t-statistic improved. One such regression is shown in Table 2.

One of the most interesting results of the MRR study was the negative (significant) relationship between property values and percent Negro (N). This result is somewhat counter-intuitive and is contrary to the findings of other researchers[3] who found that housing was <u>more</u> expensive in ghetto areas. Since the correlation coefficient between N and C is .43, it was

[3] See King and Mieszkowski [3] and the references therein.

likely that respecifying the model by adding C would change the estimated coefficient of N. This is indeed what happened. Since MRR used a quadratic specification (including N and N^2) the degree of change depends on the values selected for comparison, but generally the magnitude of the total race effect decreased by 30-50% when C was included in the equation. This still leaves a large, significant race effect, but brings into question whether correcting for other unincluded variables might not eliminate the effect entirely.

IV. CONCLUSIONS AND APPLICATIONS

If we are prepared to accept the estimates presented here as representing the value of reducing property crime, then several important applications are possible. In principle, it would be possible to use these estimates to compute the optimal level of criminal justice expenditures a la Becker.[4] This remains possible <u>only</u> in theory however, because we do not as yet have reliable estimates of the production function for the criminal justice system. (What is the expected change in the crime rate resulting from a change in (say) expenditures on the courts?) Research on these problems is beginning to appear, but often the results are disconcerting. For example, results from experiments in Kansas City and statistical inferences using Rochester data both indicate that the effect of an increase in police patrol may be an increase in the reported crime rate.[5]

Even if we cannot solve the complete allocation problem, partial solutions are possible. New programs may be developed which reduce the levels of property crime. It would be possible to use the estimates presented here in a cost-benefit analysis of such programs. Admittedly these estimates

[4] See Becker [1].

[5] See Thaler [6].

should be used with caution. They are based on a relatively small sample and really only apply to Rochester, New York. Hopefully they will be supplemented with further estimates using better data from additional cities. I think this research does provide believable results which may encourage others to participate in a follow-up.

TABLE 1

FULL MRR EQUATION PLUS PROPERTY CRIMES/POPULATION

Variable Name	Regression Coefficient	t-value
Eqlzd Assessment Bldg/Acre	.9344	15.8
Access: Avg Driving Time		
5-10 minutes	-.4125	-.43
10-15 minutes	224	.03
Access x Zone (Z)		
Two-family zone		
5-10 minutes	7,484	1.44
10-15 minutes	-2,350	-.37
15-20 minutes	5,213	.30
Walk-up Apartment Zone		
0-5 minutes	-13,644	-.86
5-10 minutes	9,170	1.09
Visible Uses (V)		
Multi-family Residential	-6,768	-1.75
Commercial	-648	-.16
Industrial	-8,785	-1.94
Dump or Slum	10,609	.81
Body of Water	-430	-.03
Land Recreation	4,084	.52
Xway or Busy Street	2,957	.71
Public Building	-5,832	-1.10
Vacant Land	10,697	.50
Airport	-25,793	-3.00
Adjacent Uses (A)		
Two-family Residential	-4,597	-1.15
Walk-up Apartment	-8,320	-1.08
Professional Office	12,168	.82
Neighborhood Business	-6,219	-.63
CBD or Shopping Center	-7,697	-.34
Light Industry	-1,171	-.10
Heavy Industry	1,015	.06
Gas Station	-4,596	-.19
Dump or Slum	-16,638	-.92
Recreation	-7,512	-.55
Public Building	15,034	1.53
Vacant Land	3,002	.18
Value Related Variables (X)		
Variance		
Area	-1,871	-.18
Density	-359	-.02
Commercial	-20,266	-1.26
Sale by Trustee	-30,874	-6.08
Mortgage/Acre	.623	1.58
Mortgage x Interest/Acre	-1.25	-.24
Mortgage Dummy	-51,927	-4.99
Type of Street		
Major Arterial	2,434	.15
Minor Arterial	297	.04
Collector	7,116	6,947
Maintenance		
Good	.100	1.53
Poor	-.091	-1.54
Census Variables		
Population Density	-2,402	-.51
% Negro	-31,972	-1.09
% Negro Sq.	11,435	.32
% 62 and over	5,435	.19
% in 10 unit Bldg	-1,777	.09
Avg # Rooms - Owner Occ	40,796	1.51
Avg # Owner Occ Rooms Sq	-.4042	-1.94
Avg Rm Owner Occ Missing Info Dummy	63,696	.71
Avg # Rooms - Renter Occ	290	.21
Avg Room Renter Occ Missing Info Dummy	14,167	1.97
Property Crimes/Population	-202,493	-1.83
Constant =	-8,733	
Number of Observations =	398	
R^2 =	.624	
Standard Error of the Estimate =	29,862	

TABLE 2

INSIGNIFICANT VARIABLES DROPPED

Variable Name	Regression Coefficient	t-value
Eqlzd Assessment Bldg/Acre	.9415	17.09
Visible Uses (V)		
Multi-family Residential	-8,824	-2.56
Industrial	-12,085	-3.02
Airport	-24,631	3.03
Adjacent Uses (A)		
Public Building	7,089	.81
Value Related Variables (X)		
Sale by Trustee	-31,721	-6.36
Mortgage Dummy	-4,375	-1.04
Maintenance		
Good	.1081	1.72
Poor	-.0927	-1.63
Census Variables		
% Negro	-28,331	-3.05
Avg # Rooms - Owner Occ	45,521	1.77
Avg # Owner Occ Rooms Sq	-4,560	-2.25
Avg Rm Owner Occ Missing Info Dummy	91,641	1.05
Avg # Rooms - Renter Occ	285	.21
Avg Room Renter Occ Missing Info Dummy	13,746	2.04
Property Crimes/Population	-192,396	-2.06
Constant =	-30,752	
R^2 =	.57	
Standard Error of the Estimate =	30,193	

BIBLIOGRAPHY

[1] Becker, G.S., "Crime and Punishment: An Economic Approach," Journal of Political Economy, 78 (March/April, 1968), 526-536.

[2] Griliches, Z., ed., Price Indexes and Quality Change, Cambridge, Massachusetts: Harvard University Press, 1971.

[3] King, A.T. and Mieszkowski, P., "Racial Discrimination, Segregation, and the Price of Housing," Journal of Political Economy, 81 (May/June, 1973), 590-606.

[4] Maser, S., Riker, W., and Rosett, R., "The Effects of Zoning and Externalities on the Prices of Land in Monroe County, New York," Department of Economics, The University of Rochester, April, 1974.

[5] Ridker, R.G. and Henning, J.A., "The Determinants of Residential Property Values with Special Reference to Air Pollution," Review of Economics and Statistics, 44 (May, 1967), 246-255.

[6] Thaler, R., "An Econometric Analysis of Property Crime: Interaction Between Police and Criminals," The University of Rochester, The Graduate School of Management, Working Paper #7441, 1974.

[7] Thaler, R. and Rosen, S., "The Value of Saving a Life: Evidence from the Labor Market," forthcoming in N. Terleckyj, ed., Household Production and Consumption, New York: National Bureau of Economic Research, 1975.

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