CASINOS, CRIME, AND REAL ESTATE VALUES: DO THEY RELATE?

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This study analyzes the effect of a new large export-based industry on crime in its region, and in turn on property values. Urban economic models suggest that, ceteris paribus, land values diminish with distance from a central place which "produces" employment, income and other amenities. The new industry has the negative by-product of crime, which is hypothesized to have a reversed, although systematic effect, on land values. Thus, theoretically, the net effect of (dis)amenities as a function of distance from the central city is ambiguous. Applying the model to casinos in Atlantic City shows that the frequency of violent crimes, burglaries, and robberies diminish with distance and appear to have a depressing effect on property values especially in localities accessible to the central city. The negative effect of crime diminishes with distance. The effect on property values appears to be significantly higher in the postcasino relative to the precasino era. However, the positive effects of the central city on real estate values diminish with distance. Thus development and crime affect property values inversely as a function of distance. The discounted value of the cost of crime resulting from casinos, as reflected in unrealized assessed real estate valuation, appears to be on average 24 million dollars per square mile in the 12 accessible localities, and 11.2 million dollars per square mile in the 52 less accessible localities.

The modern theory of urban land use and that of urban rents is drawn from the original Von Thünen model (1826) of agricultural land use. Alonso (1964) was the first to generalize the concept of bid rent curves. The concept was further analyzed, both theoretically and empirically, to explain the urban and regional distribution of land use and the spatial variability of rent (e.g., Muth

The authors wish to thank the two anonymous referees for their constructive comments and suggestions. The study was partially funded by a Grant-in-Aid awarded by the Senate of Temple University and partially by a 1985 Summer Research Grant of the National Institute of Justice both awarded to Dr. Simon Hakim.

JOURNAL OF RESEARCH IN CRIME AND DELINQUENCY, Vol. 28 No. 3, August 1991 288-303

1969; Mills 1972; 1980; Levy 1985, chap. 3; Fujita, 1986). The models conclude that economic activity in the "city center" explains the negative relationship between rents and distance. This suggests that economic gains in the center will be subsequently capitalized in land values. Such gains include increased employment, and new recreation, shopping, or entertainment opportunities.

Some studies have been directed at modelling the capitalization of negative externalities produced by the urban center. Fujita (1986) has considered racial bias, air and noise pollution in this context. However, little effort has been directed at the effect that crime, produced as a negative externality by the center, has on land value (Hellman and Naroff, 1979).

Regions experiencing long periods of economic decline have found the introduction of new industries to be seductive. Often these industries are export based and have been outside the traditional manufacturing sectors. Deriving the monetary estimates of the overall social costs and benefits is necessary for a decisive answer on the preferred industry.

Some studies have suggested that a byproduct brought about by the introduction of a new industry to a region is increased crime. (Friedman, Hakim, and Weinblatt 1989; McPheters and Stronge 1974; Fujii and Mak 1979; Hakim and Buck 1989). No attempt has been made to estimate monetarily the adverse effect of crime on the region. If indeed growth yields crime and its social cost is significantly high, then it should become part of the research agenda of urban and regional economists.

This article concentrates on the introduction of casino gambling to Atlantic City. Until 1978, the first year of gambling, Atlantic City had been on a steady downward spiral from its heyday as a beach resort. Prior to 1978, it was decided that the region needed a quick fix that would be related to its historical, export-based tourist industry. Much has been said about the success of gambling as an engine for growth in the Atlantic City region. Unfortunately, gambling has also attracted crime to the region. (Friedman et al. 1989, Hakim and Buck 1989, Albanese 1985).

The significance of this work is in its monetary quantification of the cost of crime as capitalized in real estate values. The introduction of crime as an explanatory variable in the valuation function captures the effect of crime on properties at various distances from Atlantic City. Further, aggregation of the costs over the whole region gives the total cost of crime in terms of altered property values which may be attributed to the introduction of casinos.

Section 1 presents the theoretical foundations on why and how crime is hypothesized to affect real estate values. Section 2 introduces the econometric model and the empirical results. Section 3 presents the capitalized benefits and costs of development captured in land values, and section 4 summarizes the major findings.

1. THEORETICAL BACKGROUND

Theories of economic land use suggest that real estate values capture the discounted present value of all locational amenities and disamenities. For example, many studies have analyzed the captured values of improved accessibility. Boyce and Allen (1972) showed that the market values of single family homes which have access to a transit system are higher than homes which are less accessible. An accessible home's market value is higher than a similar less accessible home by the discounted present value of the commuting savings of actual travel costs and the value of time saved, ceteris paribus. Clearly, these savings diminish as the real estate is located further away from the transit station. That, in turn, leads to a proportional decrease in values.

Similar studies have analyzed the capitalization of disamenities like air and noise pollution (Freeman 1979; Fujita 1986). For example, market values of homes were recorded at various distances from a commuter railroad while controlling for other variables like location and physical characteristics. Then, by using multivariate regression analysis, the cost of railroad noise as reflected in property values was calculated at various distances from the rail line. Generally, they showed that the discounted present value of costs perceived by real estate consumers are closely associated with the lower values of highly polluted residential properties (Resource Management Corporation 1971). Extending the discussion to crime, a major urban disamenity which has been neglected by urban economists, should yield a similar pattern.

People perceive the level of crime in a neighborhood/town by reputation, which in turn affects the prices offered by potential buyers of real estate. The lower price attributed to crime in a neighborhood is estimated as the discounted present value of buyers' perceived costs. If the perceived cost of crime is fully reflected in real estate values, then it becomes a very useful tool to determine the desired level of public measures to combat crime. Further, if crime depresses real estate values then the locality loses property taxes (Hellman and Naroff 1979; Naroff and Hellman 1980). Thus, because it is possible to estimate the benefits realized from enhanced policing one can determine whether it is desired, from the municipality viewpoint, to spend more on security.

The three necessary conditions that need to be satisfied in order to assume that the full perceived cost of crime is indeed captured in real estate values are:

1. Competitive real estate markets. Large numbers of buyers and sellers, and prices are freely determined.
2. Buyers and sellers of real estate are fully aware of the amenities and disamenities associated with the location of each property. This is a typical perfect competition requirement of full information in the market place.
3. All other variables that affect real estate values are isolated.

The effect of a transit system on real estate values appears to satisfy all three conditions. Indeed, empirical studies have confirmed the close association of transportation savings with differentiated values of properties (e.g., Boyce et al. 1972; Sullivan 1990, chap. 8, pp. 230-33). Where the cost of air pollution is concerned, the second condition is not satisfied. The reason is that not all pollutants are "tangibles." For example, a recent study showed that parents of children with respiratory diseases are more likely to consider air pollution in their home purchase than others do (Shechter 1988).

In the estimation of the perceived cost of crime, the first two conditions are satisfied and the third condition can be statistically satisfied. Thus the perceived cost of crime is expected to be fully captured in real estate values and can be empirically estimated through changes in values.

An important question is whether the effect on crime, which affects property values, of a centrally located new industry exhibits a systematic spatial pattern. If so, it is possible to construct a spatial prediction model of crime. Such a possibility is crucial for policymakers and planners involved in attracting new industries to a region.

Our earlier studies on the impact of Atlantic City casino gambling on crime in the region has shown that the level of crime has significantly increased since gambling started in 1978 (Hakim and Buck 1989). The sources of casino-related crime are: (a) the temporary visitors to the casinos who have criminal inclinations; (b) criminals that choose to permanently reside in the region due to the new crime opportunities "offered" by the casinos and the rapid growth that follows it; (c) crime directly and indirectly related to the forty thousand employees of the casinos and the indirect growth *they* have brought. Many of the employees reside in communities accessible to Atlantic City, are in the age group 20 to 30, and could be consumers of "soft" drugs.

Thus the crime in the region does not all originate from criminals who are residents in Atlantic City. Some may originate in other localities in the region.

However, the source of crime is related to the casino industry and the growth it yields. Economic growth appears to intensify with the proximity and/or accessibility of the locality to Atlantic City. Thus crime which, directly or indirectly, is associated with the casinos and the growth it yields, is expected to exhibit a consistent spatial distribution.

Indeed, previous studies (Friedman et al. 1989; Hakim and Buck 1989) have shown that the level of crime attributed to the casinos diminishes with the distance from Atlantic City. Violent crime, possibly exported from Atlantic City, diminished most rapidly with distance, followed by robberies, auto thefts, and burglaries. The least rapid decline with distance was that of larcenies. The decline appears to extend further along arterial roads which lead to Philadelphia and New York. However, crime showed no particular spatial pattern in the precasino years 1972 to 1977. This trend emerged in the postcasino years, 1978 to 1986. It suggests, along with other empirical evidence, that until 1978 Atlantic City did not serve its region in the role of a central city. However, it became a central city with the introduction of casinos.

The effect of casinos on property values appears to be ambiguous: positive externalities pull towards an increase in values, whereas the city's negative externalities pull towards diminished values. Based on our above discussion, it is possible to construct a behavioral model and estimate these opposing effects.

2. *DATA DESCRIPTION AND THE EMPIRICAL MODEL*

Sixty-four communities, including Atlantic City, are the base of our analysis. They are collectively exhaustive of Atlantic, Cape May, and Ocean Counties in Southern New Jersey. Observations extend over 15 years; precasino annual data for the years 1972 to 1977, and postcasino for the years 1978 to 1986, a total of 960 cases.

Crime, police manpower, population, and land use data are drawn from the state of New Jersey *Uniform Crime Reports*. The assessment of real estate and budgetary data is from the *Statements of Financial Conditions of Counties and Municipalities*, New Jersey Department of Community Affairs. Distance by miles and minutes of all localities from Atlantic City is available from a special survey of commuting patterns conducted by the New Jersey Department of Transportation. The source of the price deflator for all financial services and housing is the *Economic Report of the President*.

Previously, we suggested that crime, police, and assessed value are jointly determined. A fully specified model includes three behavioral equations for these variables. However, there are data limitations which preclude such modelling. Also, police manpower or spending responds only very slowly to the other endogenous variables. Therefore, as a strategic matter, two-stage least squares is used to estimate the structural equation of state equalized assessed value, which is the only concern of this research.

In the first stage, we estimate the equations for the various categories of crime, C^i, ($i = 1, \ldots 5$); for violent crime, burglary, auto theft, larceny, and robbery) and police manpower, POL. All C^i and POL are estimated as a function of one year lagged real estate valuations, density, unemployment rate, lagged assessed value, lagged police manpower, travel time and lagged crime. The fitted values for the crime ($\hat{C}^i$) and police manpower ($\hat{POL}$) variables are then used to explain the structural equation for assessed value.

The structural equation of total assessed value per square mile bereft of simultaneity bias (second stage) is:

$$AV = A\,(DEN, MIN, UN, \hat{POL}, \hat{C}^i) \qquad (1)$$

where, $i = 1, \ldots 5$

State equalized real estate valuation, AV, represents the market values for all localities. This variable is the product of the state's equalization ratio and the local assessment figures. The state's ratio, which is calculated annually from evidence on market sales, is aimed at deriving real market values equalized across the state. Indeed, the ratios appear to vary over time for the localities in the region, providing further evidence that the values drawn to express market real estate valuations are annually updated by the state government.

The explanatory variables are defined as follows:

DEN = number of people per square mile. The higher the density, the greater the level of assessed valuation. Higher density reflects a more urbanized community and closer proximity to economic opportunities. Thus, the hypothesized relationship is $\frac{\partial AV}{\partial DEN} > 0$.

MIN = distance in minutes from Atlantic City. This variable reflects both physical distance and quality of commuting. Suppose two identical localities are located at the same distance from the economic source, Atlantic City. The one which is more accessible, by virtue of improved highways and shorter driving time, will show higher property values due to greater transportation savings. These savings generate greater demand for housing and service industries. Thus, based on the positive economic, social, and entertainment amenities of Atlantic

City, the hypothesized relationship is expected to be $\frac{\partial AV}{\partial MIN} < 0$. On the other hand, viewing Atlantic City as a disamenity which produces and exports crime, it is expected that the export impact diminishes with distance; accordingly, the cost of crime reflected in land values is expected to be $\frac{\partial AV}{\partial MIN} > 0$. The net effect can only be derived empirically.

Distance and density may be viewed as expressing the same phenomenon. Urban economic theory suggests that density diminishes with distance from the center (e.g., Alonso 1964). However, empirical evidence suggests that unlike distance, density does not diminish in a continuous monotonic fashion from the center. Zoning ordinances and imperfections in the real estate markets cause density to behave in an irregular pattern. Indeed, the bivariate correlation between distance and density is quite low (0.11). Because the two variables express different effects they both should be included in the explanatory real estate values.

UN = Unemployment rate. As income increases, demand for housing (a normal good) increases, leading to higher prices, ceteris paribus. Because income data is unavailable on an annual basis, the unemployment rate is substituted for it and a reverse sign is expected. Thus the hypothesized relationship is $\frac{\partial AV}{\partial UN} < 0$.

$\hat{POL}$ = The predicted value of police manpower from the first stage estimation. The effect of security on land values can be measured in two ways: In the first method, more police officers on the streets may be perceived by the public as providing higher levels of security. Police, however, is merely an input in the production of security and does not necessarily lead proportionately to more security. The other common measure of security is the objective outcome of reduction in crime. It would be interesting to determine whether the input of security (police) and/or output of police (crime level) affects property values. In any case, the hypothesized relationship is: $\frac{\partial AV}{\partial \hat{POL}} > 0$.

$\hat{C}_i$ = Level of crime where i = the predicted value of the aggregated level of violent crimes (murder, manslaughter, rape, and aggregate assault), burglaries, robberies, auto-thefts, and larcenies. The cost of crime, as perceived by existing and potential residents, is negatively capitalized in the value of real estate in a fully competitive housing market. Thus the hypothesized relationship is $\frac{\partial AV}{\partial \hat{C}^i} < 0$.

In order to test for the stability of the coefficients, the model is estimated for all five categories of crime simultaneously, and also as separate equations, one for each category of crime. Obviously, in the first case, the assessed

TABLE 1: Pre-Postcasino Eras: Means and Standard Deviations of Crime, Police, and Real Estate Values

	Accessible Localities[a]			*Other Localities*		
	Before (1972-77)	*After (1978-86)*	*Percentage Change*	*Before (1972-77)*	*After (1978-86)*	*Percentage Change*
Total crime	783.4 (1252.3)	1621.5 (3459.4)	+107.0	373.9 (560.2)	520.0 (776.6)	+39.1
Violent crime	91.9 (238.0)	121.7 (279.4)	+33.0	23.3 (43.4)	25.0 (43.2)	+7.3
Burglary	119.9 (178.3)	139.4 (214.7)	+15.8	264.6 (443.8)	316.7 (446.8)	+19.7
Larceny	388.3 (522.5)	1083.9 (2570.1)	+179.1	214.7 (322.6)	330.9 (513.6)	+54.1
Vehicle thefts	69.0 (157.4)	104.6 (223.0)	+51.6	19.4 (32.1)	26.7 (42.7)	+37.6
Robbery	31.3 (86.7)	58.5 (163.2)	+86.9	4.1 (11.8)	6.8 (17.6)	+65.8
Total assessed value per sq. mile	13×10^6 (7×10^6)	21×10^6 (24×10^6)	+61.5	27×10^6 (33×10^6)	34×10^6 (45×10^6)	+25.9
Unemployment rate	89.2 (40.2)	82.6 (28.5)	−7.4	83.6 (43.2)	85.4 (41.9)	+2.1
Number of police officers	38.1 (72.0)	51.5 (92.8)	+35.2	16.9 (18.4)	20.7 (22.8)	+22.5

NOTE: Standard deviations are in parentheses.
a. The 11 accessible localities are those within 30 miles or on the average 30 minutes commuting time from Atlantic City and are not located in Cape May County.

values equation is estimated as a second stage of two equations. In the latter case it is estimated as a second stage of six equations.

Table 1 exhibits the variable means and standard deviations of accessible and inaccessible localities in the pre- and postcasino eras. The values are annual means in the appropriate period for these two groups of localities. Atlantic City, towns which are immediately adjacent, and those located within 30 miles on the major routes leading to Philadelphia and New York are defined as accessible. The rationale for that selection is based on empirical findings which show that criminals operate on familiar routes (Rengert and Waselchick 1985, chap. 3). The mean number of all crimes has increased by 15% or more, although the increase is greatest in accessible communities. Interestingly, the percentage increase in police manpower is lower than the rise in crime. The percentage increase in real estate values in accessible places is 2.4 times that of the other locales.

Table 2 presents six pairs of equations for the precasino period, denoted by an equation ending in a .1, and postcasino period, denoted by an equation ending in a .2. Before casinos, as the distance from Atlantic City increased, ceteris paribus, property values were increasing. This reflects the fact that the city did not serve as a major base for economic attraction in the region, and commuting was directed toward the north and northwest. Introduction of casinos reversed that trend; property values now appear to increase as the distance from Atlantic City diminishes. Burglaries, robberies, and auto thefts have a depressing effect on property values. The effect of the other crimes does not appear to be conclusive. Density, which expresses the degree of urbanization, appears to be consistently positive in its effect on property values in all equations.

Police manpower, or the input for security, appears as possibly having positive effect on real estate valuation, indicating that more policing may be perceived as better security. On the other hand, police manpower may express the level of expenditures/income of localities. Because manpower is a major expense for municipalities and the share of police in total expenditures remains constant over time, this variable is a proxy for expenditure (and revenue) in the community. Because the major income source of localities is real estate taxes, it is expected that a high covariance exists between police and real estate assessment. Also, police affect the level of crime. Thus inclusion of both police and crime in explaining real estate valuation yield "double counting" of the same phenomenon.

Due to the possibility that POL and AV express the same phenomenon, we chose to analyze AV without including POL on the right side in the next specification of the empirical model (Table 3). In this effort to test the effect of casinos on the regional economy vis-à-vis the cost of crime, the following two equation recursive system (equation 2) is estimated in the first stage:

$$\begin{aligned} C_t^i &= C(C_{t-1}^i, POL_{t-1}, AV_{t-1}, UN) \\ POL_t &= P(C_{t-1}^i, DEN, POL_{t-1}, AV_{t-1}) \end{aligned} \tag{2}$$

The structural equation for per square mile total assessed values is estimated in the second stage:

$$AV_t = AV(\hat{C}_t^i, DEN, PD, TD, MIN \times PD, MIN \times TD, MIN, UN) \tag{3}$$

where the circumflex (^) indicates the fitted value from the first-stage estimation.

The new variables introduced are:

TABLE 2: Total State Equalized Assessed Valuation per Square Mile (AV_t),[a] Second Stage Pre- and Postcasinos Two Equations

	Two-Stage Least Squares												
Equation[b]	*DEN*	*MIN*	*UN*	*VÎO*	*BÛR*	*RÔB*	*AÛT*	*LÂR*	*PÔL*	*Constant*	R^2	F	DF
1.1	0.936	0.114	0.057	0.003	–0.214	–0.246	–0.309	0.459	0.213	–1.234	.87	233.3	310
	(26.1)	(1.9)	(0.7)	(0.05)	(–2.1)	(–3.1)	(–3.09)	(4.4)	(2.5)	(–2.7)			
1.2	1.085	–0.204	0.192	0.004	–0.192	–2.18	–0.368	0.401	0.210	–0.622	.85	403.0	628
	(41.5)	(–4.3)	(2.7)	(0.054)	(–2.6)	(–4.1)	(–4.9)	(4.7)	(3.1)	(–1.7)			
2.1	1.044	0.308	0.009	–0.212					0.164	–0.936	.84	328.4	314
	(32.5)	(5.2)	(0.105)	(–3.2)					(3.8)	(–2.1)			
2.2	1.170	–0.070	0.202	–0.322					0.087	–0.084	.82	594.4	633
	(47.3)	(–1.4)	(2.6)	(–4.9)					(2.7)	(–0.2)			
3.1	0.938	0.295	0.029		–0.387				0.422	–0.343	.85	350.4	314
	(24.5)	(5.1)	(0.4)		(–5.5)				(6.3)	(–0.8)			
3.2	1.067	–0.035	0.175		–0.378				0.343	0.095	.84	637.0	633
	(39.2)	(–0.80)	(2.5)		(–8.0)				(7.3)	(0.3)			
4.1	0.973	0.253	0.053				–0.401		0.443	–1.12	.86	379.6	314
	(30.2)	(4.5)	(0.7)				(–7.4)		(7.7)	(–2.9)			
4.2	1.085	–0.116	0.224				–0.460		0.399	–4.13	.84	673.6	633
	(43.4)	(–2.6)	(3.3)				(–9.9)		(8.7)	(–1.2)			
5.1	–0.003	0.008	0.021					0.069	0.920	–0.186	.97	1815.7	314
	(–0.3)	(0.4)	(.8)					(3.5)	(41.2)	(–1.4)			
5.2	0.098	–0.075	0.263					0.047	0.799	–0.811	.82	568.6	633
	(5.8)	(–2.5)	(5.5)					(1.5)	(21.9)	(–3.1)			
6.1	–0.002	0.033	0.025			0.048			0.960	–0.116	.97	1805.4	314
	(–0.2)	(1.7)	(.9)			(3.3)			(63.8)	(–0.9)			
6.2	1.111	–0.197	0.257			–0.491			0.365	–0.813	.85	710.1	632
	(47.5)	(–4.3)	(3.8)			(–11.5)			(9.3)	(–2.5)			

NOTE: All variables are expressed in their natural logarithmic form. The numbers in parentheses are *t* values.
a. The dependent variable is the ratio of total assessed valuation, and the multiplication of the state equalization rates by the land area (in square miles), and by the price index of housing.
b. An equation number which ends in .1 indicates those from the precasino period; .2 indicates those from the postcasino period.

Location of municipality with respect to Atlantic City:

$$PD = \begin{cases} 1 \text{ if locality is accessible} \\ 0 \text{ otherwise} \end{cases}$$

Year with respect to pre-post casinos operation.

$$TD = \begin{cases} 1 \text{ if } 1978 \leq \text{year} \leq 1986 \\ 0 \text{ if } 1972 \leq \text{year} \leq 1977 \end{cases}$$

All crimes but larcenies appear to depress property values, a result which is consistent in both specifications of the model (equation 1, in both Tables 2 and 3).[1]

It is evident from Table 1, that the effect of distance from Atlantic City on property values, before controlling for other factors, is positive prior to 1978. This reflects a lack of economic attraction to the city. However, in the postcasino period, property values have increased by 61.5% localities directly affected by the casinos and by only 25.8% in other places. Casinos did become an economic attraction in the whole region for all places in the postcasino period as indicated by the negative sum of coefficients for the appropriate combinations of MIN terms in Table 3. Thus property values diminish as the commuting distance in minutes increases. The decline is more rapid in the postcasinos years for the accessible places by the magnitude of the MIN × PD coefficient. Equation 1 of Table 3 further strengthens previous findings; ceteris paribus, assessed values have increased significantly more in the postcasino, relative to the precasino, period for accessible localities than did values in the less accessible areas for the same two periods.

3. THE COST OF CRIME

In stage 1, five equations for the five types of crime are estimated using the pooled data for the precasino period (1972-77). Suppressing the location subscript, the equation is:

$$\hat{C}_t^i = \hat{a} + \hat{b}C_{t-1}^i + \hat{c}POL_{t-1} + \hat{d}UN_t + \hat{e}DEN_t + \hat{f}AV_t + \hat{g}MIN \qquad (4)$$

The estimated coefficients a through g are extracted for the five equations crime in order to predict crime under the scenario that the precasino crime incidence remains the same in the postcasino era. In order to do so, the values of $\hat{C}_t^i$ are forecasted (equation 4) for the postcasino era with the precasino average of crime and POL (for 1972-77) as the lagged values of crime and police and the postcasino values for DEN, MIN, and UN.

TABLE 3: Total State Equalized Assessed Valuation per Square Mile (AV_t), Second Stage Pooled for All Years 1972-86

	Two-Stage Least Squares														
Equation	*DEN*	*MIN*	*UN*	*VÎO*	*BÛR*	*RÔB*	*AÛT*	*LÂR*	*PD*[a]	*TD*[b]	*MIN* × *PD*	*MIN* × *TD*	*Constant*	R^2	F
1	1.091	0.016	0.218	−0.081	−0.035	−0.450	−0.379	0.604	0.614	1.079	−0.292	−0.286	−2.112	.89	617.0
	(64.1)	(0.3)	(4.7)	(−1.9)	(−0.7)	(−10.0)	(−7.9)	(15.4)	(2.3)	(5.0)	(−4.0)	(−5.0)	(−6.6)		
2	1.175	0.103	0.271	−4.520					−0.191	1.255	−0.060	−0.344	−0.350	.85	610.3
	(67.3)	(1.4)	(4.9)	(−10.4)					(−0.6)	(4.8)	(−0.8)	(−5.0)	(−1.0)		
3	1.168	0.186	0.114		−0.104				−0.231	1.235	−0.051	−0.331	−0.896	.83	542.7
	(63.1)	(2.3)	(2.0)		(−3.9)				(−0.7)	(4.5)	(−0.6)	(−4.6)	(−2.4)		
4	1.178	0.190	0.163				−0.190		0.167	1.266	−0.157	−0.326	−1.147	.84	573.8
	(65.7)	(2.5)	(3.0)				(−7.6)		(0.5)	(4.7)	(−1.8)	(−4.6)	(−3.2)		
5	1.170	0.132	0.037					0.041	−0.860	1.165	0.105	−0.321	−0.977	.83	534.0
	(62.3)	(1.7)	(.7)					(1.8)	(−2.7)	(4.2)	(1.2)	(−4.4)	(−2.6)		
6	1.179	0.185	0.218			−0.311			0.808	1.240	−0.328	−0.314	−1.513	.85	623.5
	(68.1)	(2.5)	(4.1)			(−11.3)			(2.6)	(4.8)	(−3.8)	(−4.6)	(−4.3)		

a. Place Dummy = { 0 if less accessible; 1 if accessible

b. Time Dummy = { 0 if 1972 ≤ year ≤ 1977; 1 if 1978 ≤ year ≤ 1986

TABLE 4: Total Assessed Values per Square Mile (in $\$10^6$)

	Accessible	*Less Accessible*
Precasinos		
1. Reported (1972-77)	7.053	8.121
Postcasinos		
2. Reported (1978-86)	10.113	9.802
3. From model (Table 3, eq.1) using actual crime	10.201	9.555
4. From model (Table 3, eq.1) using crime forecast from precasino period	11.240	10.080
Number of localities	12	52

NOTE: The assessed values differ from Table 1 because they have been adjusted by the State Equalization Ratios which correct for different assessment practices set by the localities.

The forecasted values of $\hat{C}_t^i$ are inserted in equation 1 of Table 3, to obtain a prediction of total assessed values per square mile in the absence of casinos where the values of TD equal zero. Thus we obtain a prediction of what property values would have been, on average, had the post-1978 growth been accompanied by the expected crime levels of the precasinos period, rather than the much higher crime rates which were actually experienced.

Table 4 exhibits the estimates of total assessed value per square mile of equation 1 of Table 3 using the precasino data. Rows 1 and 2 indicate assessed valuation as derived from the raw data. It shows that localities accessible to Atlantic City had few economic ties with the city in the precasino era, and exhibited values lower by 15% than other places. In the postcasino years, the relationship is reversed; accessible values have risen by 43.4%, inaccessible by 20.7%, yielding higher property values in accessible rather than in inaccessible places. Localities accessible to Atlantic City now show significant increases in values, possibly resulting from a greater economic dependency on the casinos.

Row 3 indicates the assessed values as predicted from the second stage model (Table 3, equation 1). The difference between row 3, a within-sample fitted value, and row 2, the actual assessed value, is insignificant, implying the power of the model in replicating reality. The estimated model appears to reflect the observed data quite well.

Row 4 of Table 4 is the estimated assessed valuation derived from the forecasted crimes in the absence of casinos. Or, if the area had experienced the precasino projected crimes and the same regional growth, then property values would have reached those levels expressed in row 4. Thus the cost of casino-related crime is the difference between rows 3 and 4. This cost may

TABLE 5: **Total Assessed Values (in $\$10^6$)**

	Accessible	*Not Accessible*
Precasinos		
1. Reported (1972-77)	1,954.0	8,590.7
Postcasinos		
2. Reported (1978-86)	2,801.8	10,890.1
3. From model (Table 3, eq.1) using actual crime	2,826.2	10,615.7
4. From model (Table 3, eq.1) using crime forecast from preperiod	3,144.0	11,199.0
5. Number of localities	12	52
6. Pre- to posttotal increase in value 2 – 1	847.8	2,299.4
7. Total cost of crime attributed to casinos 4 – 3	287.8	583.3
8. Cost of crime per community 7/5	23.98	11.2

have been on the average $1,039,000 per square mile in the 12 accessible localities.[2]

Table 5 provides a different view of the cost of crime to the community in terms of assessed value. Lines 1 and 2 show actual unscaled total assessed value for the two types of community, before and after casinos. Line 3 shows fitted assessed value when the actual incidence of crime is used in the estimating equation. Line 4 shows fitted assessed value when the model is simulated using the precasino incidence of crime. The bottom line, line 4 minus line 3 divided by the number of municipalities in the group, is that the cost of crime in accessible areas is $\$23.98 \times 10^6$ per municipality. In less accessible areas the loss is $\$11.2 \times 10^6$ per municipality. In either group, this can result in a large tax revenue loss, similar to the results estimated by Hellman and Naroff (1979).

4. CONCLUSIONS

The study tested the effect of casino-related crime on real estate values. The empirical results suggest that all crimes, except larceny depress property values. The cost of crime is higher in the accessible localities, where more crime results from casinos, than other localities in the region. The study provides possible monetary estimates of the cost of crime. The cost of crime seems to be of a significant order of magnitude.

The result may encourage regional scientists to consider the adverse effects of crime on property values, in addition to the effects on property values of "traditional" externalities like transportation, pollution, and local public expenditures. The result should also give pause to policymakers who are considering the use of casinos as a machine for growth in depressed regions.

However, most importantly, the study suggests the application of a fundamental, Von Thünen model (or its reverse) to explain the spatial distribution of crime and its effect on real estate values. Thus it provides a basis for more theoretical and empirical work which may bridge the wide gap between Criminology and the fields of Regional Science and Urban Economics. Criminology explains criminal inclinations and the causes of criminal behavior. Regional Science can add to the theory by explaining the spatial choice of criminals, and offering models to describe the spatial mosaic of crime.

A follow-up study may lead to important policy implications. Estimation of the cost of crime may suggest the appropriate magnitude of public security measures. Quantification of the deterrent effect of police on crime incorporated with our findings of the cost of crime as reflected in real estate values may suggest the amount to be spent on policing.

From the government viewpoint, crime reduces real estate values. Reduced values result in less taxes collected by the county and the township. Thus, if indeed the police deter crime, then we are able to calculate the necessary increase in police outlays necessary to offset the reduction in government tax receipts caused by crime.

NOTES

1. Violent crime appears to depress property values. In another study by Little (1988), which is based on market values of identical residential single family homes, it was estimated that violent crimes committed in a property yields approximately a 15% decline in values.

2. To give some perspective, this is $405 per lot in state equalized assessed value if the average property is .25 acres in size.

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