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Summary. Urban economic models suggest that, *ceteris paribus,* land values diminish with distance from a central business district (CBD) which 'produces' employment, income and other amenities. A new industry like casino gaming may have jobs and increased income associated with it. These amenities will induce an increase in property values. The size of that increase diminishes with distance from the city centre. The new industry may have the negative by-product of crime, which is hypothesised to have a reversed, although systematic, effect upon land values. That is, it pays to live in the hinterlands far from the source of crime. Thus, theoretically, the net effect of amenities as a function of distance from the central city is ambiguous. Applying the model to Atlantic City shows that the casinos have brought jobs, additional income and greater real estate values to the region, but the positive impact diminishes with distance from the city centre. However, crime has increased at a rate greater than that which existed prior to the casinos. The cost of crime resulting from casinos, as reflected in unrealised assessed real estate valuation, appears to be on average $5.2m per square mile in 1986 (current prices) in the South Jersey area. For an average community in the area it would amount in 1986 to a total of approximately $105m.

1. Introduction

The modern theory of urban land use, and that of urban rents, are drawn from the original Von Thünen (1826) model of agricultural land use. Alonso (1964) was the first to generalise the concept of bid rent curves. The concept was developed further to explain the urban and regional distribution of land use and the spatial variability of rent (e.g. Muth, 1969; Mills, 1972, 1980; Levy, 1985, ch. 3; Fujita, 1986). The models conclude that economic activity in the 'city centre' explains the negative relationship between land value, capitalised in rents, and distance from the centre. This suggests that economic growth and development in the 'city centre' will be subsequently capitalised in land values. Such gains include increased employment and new recreation, shopping and entertainment opportunities.

Some studies have been directed at modelling the capitalisation of negative externalities produced by the urban centre. Fujita (1986) has considered racial bias and air and noise pollution in this context. However, little effort has been directed at

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the effect that crime, produced as a negative externality by new development in the centre, 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 associated with these new industries is necessary for a decisive answer on the preferred industry.

Some studies have suggested that an important by-product brought about by the introduction of a new industry to a region is increased crime (McPheters and Stronge, 1974; Fujii and Mak, 1979; Friedman *et al.*, 1989; Hakim and Buck, 1989). No attempt has been made to estimate the adverse monetary effect of crime upon 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 charged with evaluating the introduction of new industries in a city or region.

This paper 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 (Albanese, 1985; Friedman *et al.*, 1989; Hakim and Buck, 1989).

The significance of the present work is in its monetary quantification of the cost of crime as capitalised 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 2 presents the theoretical foundations on why and how crime is hypothesised to affect real estate values. Section 3 introduces the econometric model and the methodology. Section 4 presents the empirical results and the capitalised benefits and costs of development captured in land values, and section 5 summarises the major findings.

2. Theoretical Background

Theories of economic land use suggest that real estate values capture the discounted present value of all locational amenities and disamenities. There are three necessary conditions that need to be satisfied in order to assume that the full cost of amenities is captured in real estate values. Firstly, real estate markets must have many buyers and sellers, with no dominant agents on either side of the transaction. Secondly, buyers and sellers of real estate must be fully aware of the amenities and disamenities associated with the location of each property. These first two assumptions are the typical perfect competition requirements of large numbers and full information in the market-place. Thirdly, other variables that affect real estate values are measurable.

For example, many studies have analysed the captured value of improved accessibility. The effect of a transit system on real estate value appears to satisfy all three conditions. Indeed, empirical studies have confirmed the close association of transportation savings with differentiated values of properties. Boyce *et al.* (1972) showed that the market values of single-family homes which have access to a transit system are higher than of homes which are less accessible. An accessible home's market value is higher than that of a similar, less accessible home by the discounted present value of the commut-

ing 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 (see also Sullivan, 1990, ch. 8, pp. 230–233).

Similar studies have analysed the capitalisation of disamenities like air and noise pollution (Freeman, 1979; Fujita, 1986). 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 disease are more likely to consider air pollution in their home purchase than are other parents (Schechter *et al.*, 1988).

As an example of noise pollution, market values of homes were recorded at various distances from a commuter railway while controlling for other locational and physical characteristics. Then, by using multivariate regression analysis, the cost of railway noise as reflected in property values was calculated at various distances from the railway line. Generally, the study showed that the discounted present values of costs perceived by real estate consumers are closely associated with the lower values of highly polluted residential properties (Resource Management Corp., 1971).

Extending the discussion of crime, a major urban disamenity which has been neglected by urban economists, should yield a similar pattern. In the estimation of the perceived cost of crime, the first condition is satisfied. The second informational assumption may be satisfied with some lag. The third condition can be satisfied statistically. 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 (see Hellman and Naroff, 1979).

People perceive the level of crime in a neighbourhood or town by reputation, which in turn affects the prices offered by potential buyers of real estate. The lower price obtained for a property in a high crime neighbourhood can be interpreted as the discounted present value of buyers' perceived costs due to crime. 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.

Now suppose that a new industry is introduced to a region. The direct impact of the new industry is to raise the level of the bid rent gradient and perhaps change its slope. But if the new industry brings additional crime as a by-product then the shift in the bid rent gradient may be somewhat ameliorated.

Studies of Atlantic City have shown the positive job and income impacts of gambling on Atlantic City (New Jersey, 1987). Other studies have concentrated on the disamenities associated with gambling. Friedman *et al.* (1989) and Hakim and Buck (1989) have shown that the level of crime has significantly increased since gambling started in 1978 and that the level of crime attributed to the casinos diminishes with distance from Atlantic City. The sources of casino-related crime are the temporary visitors to the casino who have criminal inclinations, criminals who choose to reside permanently in the region due to the new crime opportunities 'offered' by the casinos and the rapid growth that follows them, and the crime directly and indirectly related to the 40000 employees of the casinos and the indirect growth they have brought. Also, many of the employees reside in communities accessible to Atlantic City, are in the age group 20–30, and are believed to be consumers of 'soft' drugs.

Thus, the crime in the region does not all originate with criminals who are resident in Atlantic City. Some may originate in other localities in the region. However, the source of crime is related at least indirectly 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.

Crime diminishes with increasing distance from Atlantic City. 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 pre-casino years, 1972–77. The pattern observed now has only emerged in the post-casino years, 1978–86. 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 exposition of the model can be enhanced by reference to the four-panel diagram in Figure 1. In the first quadrant is the demand for housing. The rent gradient is on the vertical axis and the quantity of housing (H) is measured on the horizontal axis. Such a downward sloping demand curve would be derived from a utility (U) maximisation problem of the sort:

$$\max_{Z,\,H,\,x} U(Z,\,H,\,C(x))$$

subject to a budget constraint (Y):

$$Y = Z + V(x)H + T(x) + IC(x)$$

where x is distance from the city centre, Z is a composite good with price equal to 1, $V(x)$ is the price of a unit of housing at a distance x from the city centre, $T(x)$ is travel cost, $C(x)$ is the amount of crime at distance x from the central business district (CBD) and I is the loss per crime. Including crime in both the utility function and the budget constraint provides it with both pecuniary and non-pecuniary roles in the model.

The first quadrant also has the supply curve of housing. It is upward sloping since there may be undeveloped land and there may be opportunities to alter the existing stock. There is also the opportunity of tearing down existing housing and providing more housing on a fixed amount of

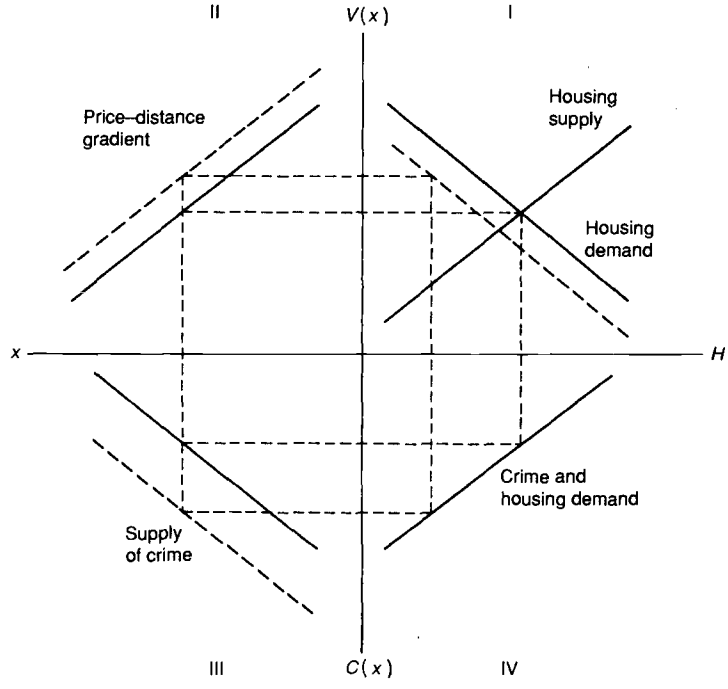

Figure 1. Crime and property value model.

land. The effect of economic growth is to shift the supply curve away from the origin.

The second quadrant, which shares the vertical axis with the first quadrant, has distance from the city centre on the horizontal axis. The curve shows the relationship between the price of housing and distance from the CBD. The price of housing, or bid rent gradient, is inversely related to the distance from the CBD. This is a now standard result (see Fujita, 1986, 1989). The position and level of the price–distance gradient will be determined by the allure of the CBD. Part of the allure of the CBD is the opportunity for employment. Therefore, anything which changes such opportunities will shift the gradient away from the origin.

The third quadrant shows the relationship between distance and the incidence of crime. The relationship can be derived from the criminal's maximisation problem; namely, the criminal must choose the distance and the number of crimes to commit in order to maximise his profits. That is,

$$\max_{N,\,x} TR(C,\ V(x)H) - TC(T(x),\ C)$$

where C is the number of crimes to be committed, N is the stock of housing, $T(x)$ is again travel cost and $V(x)H$ is the total value of housing available for victimisation. Total revenue, TR, is a decreasing function of distance since $V(x)$ is decreasing and hence the value of potential victims is less. It is an increasing function of C, but at a decreasing rate, because more crimes mean more loot and there must be a diminishing ability to fence stolen property. Total cost, TC, increases in both x and C. The presumption that it is increasing in x is obvious: it costs more to travel further and the hinterlands are less familiar and hence more costly to exploit. It is also increasing in the number of crimes. This is not so obvious in the Becker type models in which embarking on crime is like a binomial lottery. The correct formulation involves the use of the geometric probability distribution, in which the probability of remaining at large for C successive crimes is lower than that for $C-1$ crimes. Since TR is decreasing in x and TC is increasing in x, the number of crimes committed by the criminal must diminish with distance from the CBD (for models of the criminal outlined here, see Buck *et al.*, 1985, 1989). The parameters which determine the location and slope of the crime curve include the likelihood of apprehension and incarceration.

The fourth quadrant shows the demand for housing as a function of the number of crimes. The curve is also derived from the consumer's maximisation problem. At a given distance from the CBD, the consumer will demand more housing as the number of crimes falls.

The recent historical record as it has been outlined in Atlantic City suggests that the introduction of casino gaming has brought jobs to the region. This will shift the price–distance gradient away from the origin. By itself, this would shift the demand curve in the first quadrant away from the origin. Total spending on housing will increase, i.e. assessed values will go up. However, the evidence is that the casinos have brought crime with them, shifting the crime curve away from the origin. This will have the effect of shifting the housing demand curve back towards the origin. Total spending on housing will decrease, i.e. assessed values will decline. To complicate matters further, there is ample evidence to suggest that the supply curve of housing in the Atlantic City area has shifted to the right. On balance, the effect of the introduction of casino gaming as a growth enhancing strategy can be known only empirically.

The effect of casinos upon property values appears to be ambiguous: positive externalities pull towards an increase in property values, while the city's negative externalities pull towards diminished values. It is possible to construct an empirical model based upon our above discussion and quantify these opposing effects.

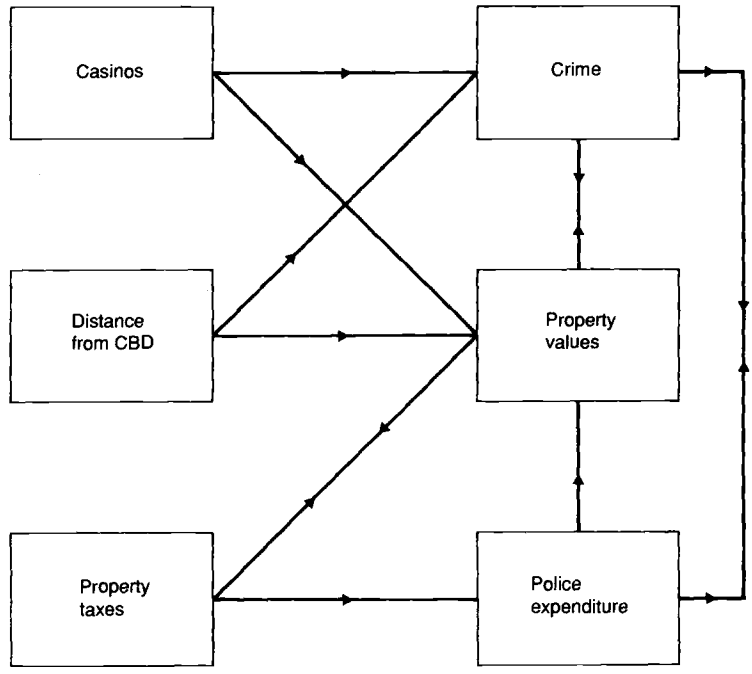

Figure 2. Variables flow chart.

3. Data Description, the Empirical Model and the Methodology

Figure 2 is a flow chart which summarises the theoretical arguments and is the basis from which the econometric model has been constructed. It suggests the need for a systems approach to evaluating the impact of casinos and crime on property values in a Von Thünen model. The next section presents a two-stage least-squares model of these relationships.

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 of pre-casino annual data for the years 1972–77, and post-casino data for the years 1978–86; a total of 960 cases.

Crime and police manpower data are drawn from the *New Jersey Uniform Crime Reports* (State of New Jersey, Attorney General). The assessments of real estate, population, demographic and budgetary data are from the *Statements of Financial Conditions of Counties and Municipalities* (State of New Jersey, Division of Local Government Services). The distance in 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* (The White House).

Section 2 suggests that crime and assessed value are jointly determined. They both depend on distance from the city centre and its rate and source of economic development. Moreover, we assume that they both affect and are affected by the level of police expenditure. A fully specified structural model includes three behavioural equations for the three endogenous variables: the property crime level, the size of police expenditure and the value of real estate.

A two-stage least-squares method is used to estimate the following three equations:

$$C_{it}=\alpha_1+\beta_{11}PE_{it}+\beta_{12}POP_{it}+\beta_{13}+V_{it}+\beta_{14}U_{it}+\beta_{15}DIS_{it}+\varepsilon_1 \quad (1)$$

$$V_{it}=\alpha_2+\beta_{21}C_{it}+\beta_{22}PEX_{it}+\beta_{23}TAX_{it}+\beta_{24}DIS_{it}+\beta_{25}DEN_{it}+\varepsilon_2 \quad (2)$$

$$PEX_{it}=\alpha_3+\beta_{31}C_{it}+\beta_{32}GE_{it}+\beta_{33}TAX_{it}+\varepsilon_3 \quad (3)$$

where C denotes total property crime and PE is a measure of police efficiency. It is the ratio of the cost of policing to the clearance rate. When the ratio falls it means that it costs the police department less to clear a crime by arresting a suspected perpetrator. POP denotes population, V is the state of equalised real estated valuation per square mile across communities equalised in constant dollars, U denotes unemployment and DIS is the distance in minutes from Atlantic City. PEX denotes police expenditure, TAX is the property tax rate on real estate, DEN is a measure of population density per square mile and GE is total local government expenditure. The three simultaneous equations were estimated using a pooling technique with i denoting the locality ($i=1, \ldots, 64$) and t denoting the year ($t=1972, \ldots, 1986$). All the variables that are expressed in money terms are measured in constant 1970 dollars.

The major interest of our present study is in analysing the combined effect of economic development, as represented by the establishment of casinos, and of the emerging crime on the value of real estate. Thus we focus and elaborate on equation (2) above.

State equalised real estate valuation per square mile represents the market values for all localities. This variable is the product of the state's equalisation ratio and the local assessment figures. The state's ratio, which is calculated annually from data on market sales, is aimed at deriving real market values equalised 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 urbanised community and closer proximity to economic opportunities. Thus, the hypothesised relationship is

$$\frac{\partial V}{\partial DEN}>0.$$

DIS: distance in minutes from Atlantic City. This variable reflects both physical distance and quality of commuting. Suppose there are two identical localities, which 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 upon the positive economic, social and entertainment amenities of Atlantic City, the hypothesised relationship is expected to be

$$\frac{\partial V}{\partial DIS}<0.$$

On the other hand, viewing Atlantic City as a disamenity which produces and exports crime, it is expected that the impact diminishes with distance. Thus, the cost of crime reflected in land values is expected to be

$$\frac{\partial V}{\partial DIS}>0.$$

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 centre (e.g. Alonso, 1964). However, empirical evidence suggests that unlike distance,

density does not diminish in a continuous, monotonic fashion from the centre. 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). Since the two variables express different effects, they should both be included in the real estate valuation function.

PEX: police expenditure. The effect of security upon land values can be measured in two ways. In the first method, more police expenditure leading to more policemen on the streets may be perceived by the public as providing higher levels of security. The police, however, are merely an input in the production of security and do 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) affect property values. In any case, the hypothesised relationship is

$$\frac{\partial V}{\partial PEX} > 0.$$

C: level of property crime. The cost of crime, as perceived by existing and potential residents, is negatively capitalised in the value of real estate in a fully competitive market. Thus, the hypothesised relationship is

$$\frac{\partial V}{\partial C} < 0.$$

The *TAX* variable, which is measured as the rate of local property tax, is assumed to have a negative effect on property value. This relationship has been hypothesised in many studies (see the seminal work of Rosen and Fullerton, 1977). Thus, we expect

$$\frac{\partial V}{\partial TAX} < 0.$$

Equations (1) and (3) represent standard theory in the economics of crime. They reflect the hypotheses that crime is deterred by police efficiency measures such as clearance rates, a variable which is strongly correlated with our measure of police effectiveness. Furthermore, crime is assumed to be attracted by wealth, reduced by distance and enhanced by socio-economic conditions such as poverty and unemployment. On the policy side, police expenditure is assumed to be an endogenous variable affected by the crime level and other local fiscal policy variables.

The above system of structural equations initially serves as a device to develop insights into the effects of casino activity and gambling on criminal activity, real estate values, tax revenue and more. However, such equations when estimated could be used numerically to assess the net effect of casino gambling on crime, real estate value and police expenditure.

In section 4 we show the results of the following assessment procedure. The simultaneous estimation of equations (1), (2) and (3) generates two coefficient matrices: the first, $\mathbf{A}$, is a 3×3 matrix involving the coefficients of the three endogenous variables, and the second, $\mathbf{B}$, is a 3×8 matrix including the coefficients of the exogenous variables and the autonomous terms.

The whole equation system may be written as follows:

$$\mathbf{Ay} + \mathbf{Bx} = 0 \tag{4}$$

where $\mathbf{x}$ denotes the 8×1 vector of exogenous variables and $\mathbf{y}$ is the 3×1 vector of endogenous variables. Equation (4) above may be rewritten as follows:

$$\mathbf{y}_t = \mathbf{C}\mathbf{x}_t \tag{5}$$

where $\mathbf{C} = -\mathbf{A}^{-1}\mathbf{B}$; $\mathbf{y}_t$ would represent the vector of estimated (computed) values of the endogenous variables, for each relevant year.

Let us recall that the simultaneous equations' coefficients are estimated with pooled data combining 64 localities and 15 annual observations (1972–86) for each locality. Now, since we are interested in assessing the effects of casino gambling, we

make two separate estimates of the equations. The first is for the pre-casino period, 1972–77, and the second is for the post-casino era, 1978–86.

In order to assess the effect of casinos, we use the pre-casino set of coefficients and the post-casino average values (for all localities) of the exogenous variables. This calculation yields, for each year in the post casino-period (1978–86), synthetic estimates of the endogenous variables, $\hat{\mathbf{y}}_t$. These estimates indicate what would have been the average annual levels of crime, property values (per square mile) and police expenditure in the post-casino era, had casinos not been established in 1978.

The comparison of these estimates with the respective actual values provides an evaluation of the effects of casino gambling on the three endogenous variables. The numerical results are exhibited and discussed in section 4.

4. Statistical Results and Analysis

Table 1 exhibits the estimates of the structural equations for the pre- and post-casino periods. The results create the possibility of comparing two different states of the world of the Atlantic City region: before and after the establishment of casinos. This institutional change had a significant effect on the two phenomena analysed in this paper: property values and crime.

The comparison of the crime equations before and after casinos provides several interesting insights. The constant terms indicate that the overall level of property crime has been significantly higher in the whole region since 1978, when casinos started operating, than it was before. The two variables that contribute to the growth of crime, population and unemployment, have stronger coefficients in the post-casino era. This clearly shows that the area developed a stronger tendency toward criminal activity: each additional inhabitant and every new unemployed worker has generated more crime since 1978 than he (or she) did in earlier times.

Variable V, the property value per square mile, is a proxy of wealth which is assumed to attract crime. Indeed, V's coefficients in the two crime equations are positive and significant, and thus support the hypothesis that crime is motivated by the expected gains. The slightly higher coefficient of V in the post-casino crime equation possibly hints at a lower social and economic opportunity cost involved in the commission of crime, or the commission of crime at a higher marginal utility of criminal gains, in this period of time. In other words, casino gambling has brought to the area criminals who are willing to 'work' for less. This happens in spite of the better performance of police, which is represented by the higher coefficient of the police efficiency variable in the post-casino crime equation. This coefficient, when compared with the one in the pre-casino crime equation, could imply the existence of scale economies in police operations.

Crime levels are negatively related to the distance from Atlantic City. This result is compatible both with theory and other empirical findings showing that the further a community is from a CBD, the lower the level of criminal activity. In comparing the pre- and post-casino periods, we see that the distance coefficient is smaller, in absolute terms, in the former equation. This means that the decrease in crime generated by the distance from Atlantic City is stronger in the post-casino period. Clearly, it implies that casino activity generates more crime in Atlantic City than in neighbouring communities.

We now turn to the real estate value equations. The comparison of the constant term in the two equations reveals the significant overall increase in real estate values, in the whole area, resulting from the establishment of casinos. The distance variable, which had a positive and statistically significant effect in the pre-casino period, has a negative, large and significant coefficient in post-casino times. It implies that before casinos, the proximity to Atlantic City had a negative effect on real estate

Table 1. Simultaneous equations estimates of crime, property value and police expenditure (*t*-values in parentheses)

	Equation					
	Pre-casino			Post-casino		
Explanatory variables	*C*	*V*	*PEX*	*C*	*V*	*PEX*
Endogenous						
C		−0.26	2.17		−0.11	3.09
		(−6.45)	(6.78)		(−2.73)	(34.88)
V	0.34			0.39		
	(5.72)			(3.69)		
PEX		0.05			0.04	
		(6.36)			(3.92)	
Exogenous						
PE	−10.73			−17.76		
	(−3.09)			(−1.92)		
POP	5.97			8.43		
	(42.74)			(20.91)		
U	2.27			4.73		
	(6.86)			(3.79)		
DIS	−3.86	1.09		−16.34	−2.34	
	(−5.19)	(2.22)		(−6.31)	(−2.85)	
TAX		−16.63	160.83		−31.82	137.79
		(−6.33)	(10.85)		(−5.72)	(6.36)
DEN		11.10			18.11	
		(18.29)			(18.80)	
GE			0.05			0.01
			(9.39)			(6.79)
Intercept	−103.63	102.12	−923.23	11.08	188.14	−295.59
	(−2.26)	(3.53)	(−8.86)	(0.07)	(4.29)	(−2.77)
R^2	0.84	0.59	0.93	0.45	0.43	0.95

values. This pattern has clearly changed since 1978; being closer to the casino area raises property values. Other details in these equations are worth observing. The first is the tax rate coefficient, which is negative and significant in both property value equations and larger in absolute terms in the post-casino period. This can be explained by the fact that property values have become much higher since 1978, and that every rise in property tax rates implies an increase in tax payments which is larger than before the casino era. Therefore, a change in tax rates has a stronger effect on property values in the post-casino period. The second detail is that the crime level seems to have a negative and significant effect on real estate values, and a stimulating effect on police expenditure. The latter justifies the inclusion of police expenditure among the endogenous variables.

The Cost of Crime

In section 2 we applied concepts of urban economics to sustain the theoretical idea that the value of real estate reflects the present value of amenities and disamenities represented by its location. Thus, real estate values in the South Jersey area should reflect a positive effect of casino activity and a negative effect of the additional crime that such activity generates in the region. We use the method described in

Table 2. Estimated and actual values of crime and real estate value for the average community

	Estimated value based on pre-casino coefficients		Actual value			
Year	Crime occurrence	Real estate value ($m, 1970 prices, per square mile)	Crime occurrence	Real estate value ($m, 1970 prices, per square mile)	Difference in crime occurrence	Cost of crime ($m, 1970 prices)
1978	520	22.6	566	23.6	46	10.3
1979	526	22.9	633	25.0	107	23.8
1980	559	21.6	758	28.9	199	44.4
1981	579	23.6	722	33.0	143	31.9
1982	606	21.6	735	34.7	129	28.8
1983	571	22.7	711	30.6	140	31.2
1984	531	23.4	646	31.6	115	25.6
1985	564	23.3	712	33.2	148	33.0
1986	546	24.8	681	36.4	135	30.1

section 3 above and the simultaneous equation coefficients shown in Table 1 to estimate both the net effect of casinos on real estate values and the negative effect that crime has on these values. We interpret the fall in real estate values from their potential levels, that is attributable to crime, as being a measure of the cost of crime. Table 2 and Figures 3 and 4 exhibit the numerical results. Columns (1) and (2) in the table show the synthetic estimates of crime level and real estate values that would have prevailed in the area in the years 1978–86, assuming that casinos had not been established in 1978. Column (1) is plotted as the dashed line in Figure 3, and column (2) is plotted as the dashed line in Figure 4. These are estimates of the variables denoted as $\hat{\mathbf{y}}_t$ in section 3. Columns (3) and (4) are the respective actual values of the two variables. Column (3) is plotted as the solid line in Figure 3, and column (4) is plotted as the solid line in Figure 4. The numerical differences between columns (1) and (3) and between columns (2) and (4) are estimates of the contribution of casino activity to crime levels and to real estate values, respectively. Keep in mind that the figures are average values for all 64 communities in our sample.

To estimate the cost of crime as reflected

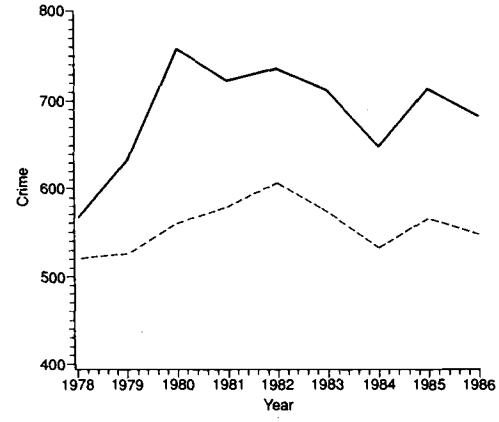

Figure 3. Estimated and actual values of crime: (- - -) estimated; (—) actual.

in property values for the average community, we take the contribution of casino activity to crime levels (column (5)), multiply it by the coefficient of crime in the post-casino real estate value equation (−0.107), and multiply it again by the average area of a community (20.8 square miles) to obtain column (6). This is the total loss in real estate value due to the crime generated by casinos for the average community in the study area. Some idea of the magnitude is provided by the vertical distance between the actual and estimated values plotted in Figure 4.

Table 3 exhibits similar figures for At-

Table 3. Estimated and actual values of crime and real estate value for Atlantic City

Year	Estimated value based on pre-casino coefficients: Crime occurrence	Estimated value based on pre-casino coefficients: Real estate value ($m, 1970 prices, per square mile)	Actual value: Crime occurrence	Actual value: Real estate value ($m, 1970 prices, per square mile)	Difference in crime occurrence	Cost of crime ($m, 1970 prices)
1978	2811	25.0	5092	16.5	2281	288
1979	2741	27.5	6232	26.0	3491	441
1980	2511	37.0	10860	44.8	8349	1056
1981	2659	44.1	11308	60.1	8649	1094
1982	2582	41.0	13585	60.6	11003	1392
1983	2492	37.9	14455	53.6	11963	1514
1984	2501	45.9	12396	71.2	9895	1252
1985	2368	22.4	14581	38.4	12213	1545
1986	2450	68.6	14064	104.2	11614	1470

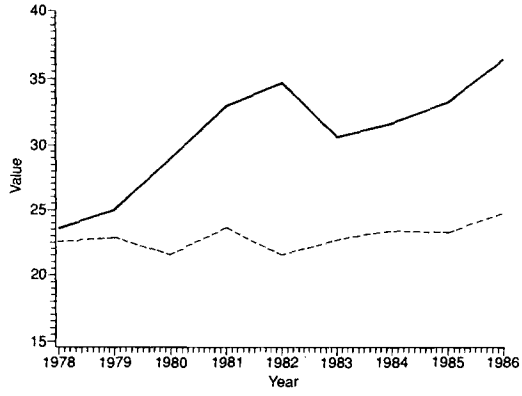

Figure 4. Estimated and actual real estate values: (---) estimated; (—) actual.

lantic City itself. In other words, Table 3 is computed the same way as Table 2. The only difference is that the exogenous variables used to estimate crime and property values are specific to Atlantic City itself.

Table 2 shows that casino activity contributed significantly to property values and criminal activity in the whole region. Property values that rose by 5 and 10 per cent in the early post-casino years were in 1986 approximately 50 per cent higher than they would have been without casino activity. There is a clear positive trend over time in the relative difference between columns (2) and (4). It is easy to explain it in terms of the dynamic and cumulative effect that intensive and growing economic activity has on the market values of a limited and constant land input. To illustrate, in 1986 the net average contribution of casino activity to property values was, in 1970 prices, $11.6m per square mile. To translate this figure to correct values of 1986 it should be multiplied by four. Had crime been at the same level as in the pre-casino period, property values would have been worth, in 1970 prices, an additional amount of $1.35m per square mile. Thus, this may be considered the economic cost of crime per square mile in 1986. This amounts to approximately 4 per cent of property values.

It might be interesting to observe how casino activity affects property value and crime in the place where it all takes place. For that purpose, see Table 3. It indicates, as clearly expected, that casino operations raised the average value of real estate in the city significantly more than in the rest of the region. In fact, in 1978 real estate values in Atlantic City were significantly lower than the average in the region, and in 1986 they were significantly (almost three times) higher. Nevertheless, casino activity also contributed to the huge increase in criminal activity, from 5092 cases in 1978

to 14 064 in 1986. Had crime remained at pre-casino levels, the average level of real estate value per square mile in 1986 would have been \$110m, in 1970 prices, higher than its actual level of \$104m, in 1970 prices. That is, the city would have been more than double its observed market value. Thus the cost of crime may be estimated at \$1.47bn per square mile, in 1970 prices, for the whole city in 1986.

5. Conclusions

The study tested the effect of casino-related crime upon real estate values. The empirical results suggest that crime depresses property values. The cost of crime is significantly higher in Atlantic City, where more crime results from casinos, than in other locations 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 urban and regional analysts 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 for thought to policy-makers 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 upon 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 behaviour. 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 in our findings of the cost of crime as reflected in real estate values may suggest the amount to be spent on policing.

From the governmental 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 one could calculate the increase in police outlays needed to offset the reduction in government tax receipts caused by crime.

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