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Douglas B. Diamond, Jr.

I. INTRODUCTION

It has long been recognized that land prices reflect the location-specific characteristics of the site as well as any unique structural characteristics of the land itself. In fact, the price of urban residential land depends primarily on its locational features or amenities. This relationship has been exploited through regression analysis to learn more about the values people place on the advantages or disadvantages of a site's location.[1] Although many recent studies have utilized hedonic analysis of dwelling values for this purpose, there have been, and continue to be, analyses of the site value alone since it is the most direct embodiment of the value of locational considerations. In addition, there is considerable interest in predicting land values for purposes of real estate analysis and tax assessment.[2]

This paper proposes three specific extensions of the methodology commonly used to relate urban land prices to locational amenities. First, we find that most amenity variables should be expressed on a per unit of land basis. Second, the marginal value of an amenity may, in general, be a function of the level of that amenity, the levels of the other amenities, of land consumption, and of residents' incomes and preferences. Third, the intercept of the land price-amenity regression should also be a function of income and preferences. All of these propositions are derived from the view that the coefficients on the amenity terms are estimators of the slopes of individuals' bid-price curves. All of these propositions find empirical support as enhancing the ability of amenity levels to explain land prices.

II. A BRIEF REVIEW OF THE LITERATURE

When computer regression analysis came into more general use, land economists took up the tool both to statistically demonstrate some propositions which they had long believed as well as to try out some new ones. Brigham's (1965) study of land prices in Los Angeles was one of the earliest and served to shape later efforts. Brigham gave considerable attention to the manner in which each amenity might affect the desirableness of a location for residential use. However, his empirical specification provided simply for a linear relationship between each measure of the

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[1] The earliest studies (see Hayes 1957, Alonso 1964) attempted simply to find any relationship between amenities and land values. Later work has emphasized estimation of the willingness-to-pay for amenities (see Nelson 1978).

[2] For example, the application of the analysis of urban land values to mass appraisal techniques is explored in a recent compendium published by the Lincoln Institute of Land Policy (1979).

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amenity and land value per square foot, for example:

$$P_L = a_1 + \sum_{i=1}^{n} b_i A_i \quad [1]$$

The implication is that the marginal effect of A_i on P_L is a constant one. This approach leads to a convenient estimate of the slope of the land price function, but it places strong restrictions on the underlying relationship between A_i and P_L.

Very similar specifications were utilized by Harris, Tolley and Harrell (1968), Downing (1970), Darling (1973) and Waldo (1970). Downing does introduce a nonlinear measure of access-to-work, but he leaves all other measures of amenities in a linear form. Several of the studies include measures of family income or lot size, but only as proxies for amenity levels, not as shifters of the partial derivatives of the land price function.

Yeats (1965), Mills (1969) and Brodsky (1970) depart from these simpler specifications by introducing nonlinear relationships, particularly with respect to access-to-work. Brodsky makes the clearest argument for doing so. He points out that what he calls the "situation rent" depends on the value of the amenity differential alone. He then notes that land prices are compounded from situation rent and "intensity rent," i.e. variations in residential density. For example, if the value of living one mile closer to work were \$1,000 *per household,* the effect on land prices of greater access would depend on the number of households per unit of land. Thus, Brodsky specifies a marginal effect of additional access on land prices that is a function of lot size, which is in turn a function of land prices.

All in all, however, most empirical specifications of the relationship between land prices and amenities have not differed substantially from equation [1]. Meanwhile, there have been a number of developments in the literature relating dwelling prices and amenities. For example, Wheaton's (1977) study of the bid-rent functions for dwellings allowed for the effect of income and other residential characteristics on the slopes of the bid-price functions. Wheaton's model is, in fact, developed in terms of rent accruing to land. Yet his empirical work is with dwelling prices and dwelling rents alone. While some of the methodological innovations suggested by him and others analyzing dwelling prices will be tried here on land prices, we find that there are several considerations which are relevant solely to the analysis of land prices.

III. THE IMPLICATIONS OF BID-PRICE THEORY

A brief review of the theory of bid-price functions reveals a number of shortcomings in specifications such as [1]. If we take Alonso's (1964) analysis and generalize it to include all locational amenities,[3] we can express the first-order condition for sustaining a utility maximum along a bid-price function as,

$$U_{A_i} = \lambda L \frac{\partial P_L}{\partial A_i} \quad [2]$$

U_{A_i} is the marginal utility of the amenity A_i, λ is the marginal utility of a composite of other goods, L is the individual's consumption of land and $\frac{\partial P_L}{\partial A_i}$ is the slope of

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[3] Amenities are defined to be location-specific "public goods." Consumption of amenities can only be varied by movement across residential locations. It does not vary with lot size. See Diamond (1978) for an extended discussion.

the land price function with respect to A_i. Equation [2] can be rewritten as,

$$\frac{\partial P_L}{\partial A_i} = \frac{V_i}{L} \quad [3]$$

where V_i is the money value of the marginal unit of A_i or $V_i \equiv \frac{U_{A_i}}{\lambda}$. Equation [3] suggests that an individual will be indifferent between two locations with marginally different levels of A_i if land prices per square foot differ by the money value of the amenity differential per square foot of land consumed. We should also note, as Alonso did, that the marginal value of the amenity may depend on many factors, such as the level of the amenity, the level of other amenities, the level of income, and characteristics of the resident that may shift the utility function. In other words,

$$V_i = V_i(A_i, A_j, L, Y, D) \quad [4]$$

where,
$j = 1 \ldots n, j \neq i$
$Y \equiv$ household income
$D \equiv$ shifters of the utility function.

Presumably, use of equation [1] is based on the proposition that $\hat{b}_i$ is a good estimator of $\frac{V_i}{L}$. Yet inspection of [3] and [4] reveals at least four important problems with equation [1]. First, only in the case where V_i and L always systematically vary together will the coefficient that compounds both of them be stable and interpretable. If the marginal valuations of the amenities are considered to be constant across all circumstances, any variation in L will lead to increased variation in $\hat{b}_i$. Thus extraction of the lot size term from $\hat{b}_i$ would aid in estimating the underlying effect of A_i on P_L. A modification of [1] to achieve this might be:[4]

$$P_L = a + \sum_{i=1}^{n} b_i \frac{A_i}{L} \quad [5]$$

A second consideration raised by [4] is that V_i may not be constant across all levels of A_i. For example, the marginal value of access-to-work may increase as the level of access declines.[5] Since $\hat{b}_i$ is now solely an estimator of V_i, it should be allowed to be at least a linear function of A_i, or,

$$b_i = b_i^1 + b_i^2 A_i \quad [6]$$

The next term in [4] is a vector of amenities other than A_i. The potential for interaction among amenities and other goods is always present unless we assume that the utility function is weakly separable in its arguments. For example, the marginal value of living nearer to a park may depend on the level of air pollution in the area or the extent of one's own private open space. These cross-effects could potentially be included in an estimating equation by specifying,

$$b_i = b_i^1 + b_i^2 A_i + b_i^3 L + \sum_{j=i+1}^{n} b_i^{j-i+3} A_j \quad [7]$$

Even if the utility function is assumed to be separable, the marginal value of an amenity for an individual is likely to depend on that individual's budget constraint and perhaps other factors which

[4] A more complex modification arises from consideration of the effect on L of the change in P_L. Such a specification is developed in Diamond (1978) and Smith (1978).

[5] In general, we might expect that the marginal values attached to any amenity would decline with higher levels of the amenity, just as an individual's demand for a good increases as its price falls.

affect one's preference for amenities. Many people hold that the value of a shorter commute depends on income, but so, too, may the value of cleaner air, parks, or safer streets. Similarly, the value of these and other amenities may depend on factors such as the number and ages of children in a household. These possibilities can be also introduced into the specification for b_i in a simple manner:

$$b_i = b_i^1 + b_i^2 A_i + b_i^3 L + \sum_{j=i+1}^{n} b_i^{j-i+3} A_j + b_i^{n-i+4} Y + \sum_{k=1}^{m} b_i^{n-i+k+4} D_k \quad [8]$$

where D_k is an element in a vector of preference shifters.

Equation [8] is the simplest possible expression for b_i which accounts for all the potential factors affecting the marginal valuation of an additional unit of the amenity A_i. It does constrain the relationship between b_i and these factors to a given form. More generally, any functional form may hold. Thus, a general statement of the propositions developed above would be:

$$b_i = b_i(A_i, A_j, L, Y, D) \quad [9]$$

which can be derived directly from the implication of [3] that $\hat{b}_i$ is an estimator for V_i once A_i is divided by L.

The factors listed in [9] act to shift the slopes of the bid-price function of an individual by shifting the numerator of the slope, V_i. In as much as the gradients are shifted by such things as income, the intercept of the function will also shift. This effect can be seen easily in the simple Alonso model. If there are two income groups in a city and the lower income group has the steeper bid-price gradient for access to the center, the lower income group will reside closer to the center, that is, consume less of the commuting disamenity. They will pay prices for land which are along their equilibrium bid-price curve (P_L^1BC in Figure 1). The higher-income residents, whose bid-price curve has a lesser slope, will reside towards the edge of the city and pay land prices which vary along the bid-price curve P_L^2BD. By the fact of the lower rate of increase in their bids with respect to access, they will bid less than the lower income group for close-in locations, including the point with the least amount of commuting ($P_L^2 < P_L^1$). In general, the bids of different groups in the city will differ at the zero amenity point (or, in this case, the zero disamenity point). Thus the intercept, a, of the relationship between land prices and amenities expressed in equation [1] is in

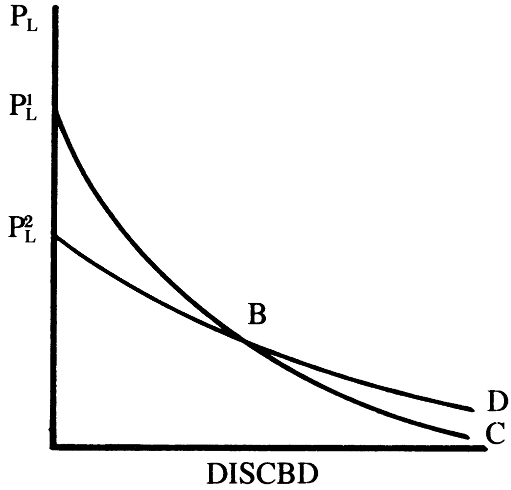

FIGURE 1
EQUILIBRIUM BID-PRICE CURVES FOR TWO INCOME GROUPS

turn a function of income and preference shifters, or,

$$a = (Y, D) \qquad [10]$$

For example,

$$a = a_1 + a_2 Y + \sum_{k=1}^{m} a_{b+2} D_k \qquad [11]$$

IV. SOME EMPIRICAL EVIDENCE

The theoretical arguments for inclusion of these additional interaction terms may seem to be relatively straightforward. If they do, it is because they amount to applying the principles of demand for ordinary goods to the analysis of the demand for, or valuations of, spatial amenities.[6] However, there is no guarantee of the empirical relevance of these interaction terms. This section develops evidence that indeed there is much information to be learned from their addition to the simpler approach of Brigham and others.

The data used for this test were obtained from a sample of the mortgage files of a large savings and loan association in Chicago. The sample consists of all their outstanding mortgages issued on new homes in the Chicago area between July, 1969 and December, 1971.[7] After exclusions for incomplete information, the data set consisted of 414 observations, located in 50 suburban municipalities. Each observation included information on the current income of the purchasers, the lot size, and the appraised value of the lot.

A variety of amenity variables were associated with each observation. The variables used here are described in Table 1, along with their means and standard deviations. They were grouped in

[6] This was the essence of Rosen's (1974) comparison of implicit goods with spatial goods.

[7] All prices and incomes will be deflated to 1970 dollars by the average rate of change in the CPI during this period, about 5% a year.

TABLE 1
DESCRIPTION OF AMENITY VARIABLES

Amenity Name	Definition	Units	Mean	S.D.
DISCBD	Distance to the CBD along major roadways	Miles	26.1	4.6
DISCRL	Distance to the nearest commuter rail station	Miles	3.0	1.3
CRIME	Incidents of crimes against persons (by municipality)	Cases per thousand persons	1.4	0.8
POL	Average annual air particulate count	Micrograms per m^3	107	9.2
LAKE	1 if within 5 miles of Lake Michigan 0 otherwise	Dummy variable	.05	0.2
TOPOG	Number of 5′ contour lines within half mile of home	Five-foot contour lines	13.9	6.8

the same manner as Brigham viewed urban amenities. There are two measures of access-to-work, distance to the CBD (DISCBD) and distance to a commuter rail station (DISCRL). There are two measures of the quality of the neighborhood environment, the crime rate (CRIME) and the level of air particulates (POL). Finally there are two natural amenities associated with each site, the hilliness of the area (TOPOG) and the proximity of the site to Lake Michigan (LAKE).

A measure of the dependent variable, the market price of land at the location of the residence, was found by dividing the appraised value of the lot by the size of the lot. This value was equated to a series of different linear specifications based on the theoretical considerations developed above. Sequentially following that development, the first three specifications are:

SPEC. 1.

$$P_L = a_1 + \sum_{i=1}^{n} b_i A_i$$

SPEC. 2.

$$P_L = a_1 + \sum_{i=1}^{n} b_i \frac{A_i}{L}$$

SPEC. 3.

$$P_L = a_1 + \sum_{i=1}^{n} (b_i^1 + b_i^2 A_i) \frac{A_i}{L}$$

The next theoretical proposition was that there may be non-zero cross-effects among amenities and between some amenities and land. The number of potential cross-effects is fairly large (twenty-one for six amenities and land). Yet some test of their potential importance is of interest. To provide one, interaction of DISCBD with each other amenity and land consumption was introduced. If we designate DISCBD to be A_1, we can express Spec. 4 as:

SPEC. 4.

$$P_L = a_1 + \sum_{i=1}^{n} (b_i^1 + b_i^2 A_i) \frac{A_i}{L} + \sum_{i=2}^{n} (b_i^3 A_i) \frac{A_1}{L} + (b_1^4 L) \frac{A_1}{L}$$

The number of other potential shifters of the marginal value of amenities is as large as the number of different preferences that people exhibit. We shall not attempt to include any here. However, the assumption that amenities are normal goods implies that, in any case, their marginal values will rise with income. We shall include income as a shifter of marginal values in Spec. 5. For the sake of brevity we shall denote the previously included terms on the left-hand side of our estimating equation as A^*.

SPEC. 5.

$$P_L = A^* + \sum_{i=1}^{n} b_i^5 Y \frac{A_i}{L}$$

Our final theoretically-founded modification is the inclusion of shifters of the constant or intercept term. Once again, income and potential members of the vector of preference shifters, D, could be included. Instead, only income and income squared will be entered to see if any further variation in P_L can be accounted for by this shift effect.[8] Thus our most complete estimating equation is:

[8] Several previous studies have included income as an independent variable to proxy for neighborhood amenities. We shall be assuming that all relevant amenities are already included and that income is only shifting the intercept.

TABLE 2
A COMPARISON OF R^2 IN SPECIFICATIONS 1–6

Specification	R^2	F-Statistic
1	.278	
2	.284	—[a]
3	.523	40.3
4	.649	23.8
5	.734	21.1
6	.749	12.3

[a] No meaningful figure.

SPEC. 6.

$$P_L = A^* + \sum_{i=1}^{n} b_i^5 Y \frac{A_i}{L} + a_2 Y + a_3 Y^2$$

The development of evidence on whether these additional terms matter will take three tacks. First, Table 2 reports on the R^2 for each of the specifications described above. Additions to the R^2 are translated into F-statistics for each group of additional terms. In general, the results are quite encouraging. Each group of terms added significantly to the explanatory power of the equation, at least in the order in which we have proposed adding them. The weakest result is the very slight rise in R^2 when the amenity variables are initially put on a per square foot basis. This is misleading, though. As will be seen in Table 3, once the equation is fully specified, the impact of this reformulation is quite significant.

A more formal measure of whether any particular modification of the specification matters is the F-test for including each modification in the final specification. The results of such a procedure are reported in Table 3. Once again, the results are quite distinctive across the board. Each modification, taken by itself, significantly enhances the explanatory power of the equation. They do so despite the high degree of collinearity between the transformations of the linear amenity variables.

TABLE 3
THE F-STATISTIC FOR EACH MODIFICATION IN SPECIFICATION 6

Group of Terms	R^2	F-Statistic
$\sum_{i=1}^{n} b_i^2 A_i$	.708	12.6
$\sum_{i=2}^{n} (b_i^3 A_i) + b_1^4 L$	.652	24.9
$\sum_{i=1}^{n} b_i Y$	.722	6.9
$a_2 Y + a_3 Y^2$	.733	12.3
$\frac{A_i}{L}$*	.653	—**

* The specification was run without dividing the amenity levels by lot size.
** No meaningful figure.

Finally, we can undertake an analysis of the coefficient on each variable to see what has been learned from these expansions of the basic specification. The raw ingredients of such an analysis, the coefficients for the terms in Spec. 6, are reported in Table 4. These estimated coefficients can be evaluated for their economic content and intuitive reasonableness.

V. INTERPRETING THE ESTIMATES

The remaining question is whether this expansion of the functional relationship between land values and amenities has uncovered additional information. Since the explanatory power of the equation has been dramatically increased by the addition of the interaction terms, we can be fairly sure that some factors affecting

TABLE 4
ESTIMATED COEFFICIENTS OF SPECIFICATION 6

Coefficients on Amenities	Amenity					
	DISCBD	DISCRL	CRIME	POL	LAKE	TOPOG
b_i^1	1274 (3.7)[a]	1181 (2.9)	−4718 (4.3)	94.6 (1.5)	−1061 (0.5)	97.3 (0.9)
b_i^2	13.5 (2.8)	−51.8 (2.1)	475 (4.2)	.724 (1.9)	—[b]	7.36 (5.5)
b_i^3, b_1^4	−.0196[c] (2.7)	−15.1 (1.0)	79.8 (2.7)	−18.2 (11.2)	−46.1 (0.5)	−12.7 (3.5)
b_i^5	−.374 (0.2)	−22.7 (2.3)	−20.8 (1.1)	1.25 (2.3)	121.2 (2.5)	−4.10 (2.2)
	Constant		Y		Y^2	
Coefficients of Intercept	.331 (1.6)		.0198 (4.9)		−.000152 (4.5)	

Estimating Equation: $$P_L = a_1 + \sum_{i=1}^{n} (b_i^1 + b_i^2 A_i)\frac{A_i}{L} + \sum_{i=2}^{n} (b_i^3 A_i)\frac{A_1}{L} + (b_1^4 L)\frac{A_1}{L} + \sum_{i=1}^{n} b_i^5 Y \frac{A_i}{L} + a_2 Y + a_3 Y^2$$

$R^2 = 0.75$

[a] Numbers in parentheses are the t-statistics.
[b] No higher order term since a dummy variable.
[c] Coefficient of b_1^4.

the marginal impact of the measured amenities on the measured land values have been accounted for. The interpretation of the specific coefficients, however, requires careful analysis.

Table 5 presents estimates of the marginal values (in 1970 dollars) of an additional unit of each amenity, based on the coefficients in Table 4 and evaluated at the mean levels of the amenities, income ($21,700), and lot size. These can be converted into an estimate of the marginal effect of an amenity on land price by dividing by the mean lot size (about 10,000 square feet). These values may vary, however, with the levels of the amenities, income and lot size.

The estimated marginal valuations are generally reasonable in sign and magnitude. The value of living one mile closer to the CBD is estimated to be $309 on a capitalized basis. This is similar to some other estimates (see Nelson 1977, 1978) derived in hedonic price studies of dwelling values. On the other hand, greater distance to a commuter rail station has only a small negative estimated effect. This raises questions as to

TABLE 5
ESTIMATED AMENITY VALUATIONS

Amenity	Marginal Valuation[a]
DISCBD	−308.6 (8.6)[b]
DISCRL	−14.6 (0.2)
CRIME	−1757.6 (10.2)
POL	−199.2 (9.8)
LAKE	2218.6[c] (2.8)
TOPOG	−118.6 (5.4)

[a] Calculated from the estimated coefficients of Spec. 6 evaluated at the mean level of all variables.
[b] Numbers in parentheses are the t-statistics.
[c] Calculated at the mean level of income for those living near the lake ($37,000).

whether these residents commute by train and whether the location of the station is inversely correlated with what does matter, the distance to a highway interchange.

The environmental amenities were also important determinants of land values. The high value placed on a lower crime rate ($1758) reflects the measure used, an index of crimes against persons. There was great variation in the crime rate across suburban municipalities (from zero to over 5 per thousand residents) so it clearly may play a major role in determining property values. Similarly, higher levels of particulate pollution will depress land values. The estimate here ($199) is higher than Nelson's (1978), but that may be because of different mean levels of the particulates or some of the interaction factors.

The two natural features have opposite effects. Proximity to Lake Michigan is clearly a valuable characteristic of a location. That much is readily apparent from observing the residential areas along the lake. This may reflect both the moderating effect of the lake on local weather and the recreational potential of the lake. It should be noted that no properties were located on or very near the lake, so the additional pleasures of a lake view are not captured here.

The hilliness of an area seems to create problems as well as pleasures, at least for the measure of hilliness employed here. The measure is based on the number of five-foot contour lines within a half-mile radius of the home site. This measure does not differentiate between rolling undulations and steeper drops. Both types of hills may raise development costs, but steeper areas also provide some scenic ambience. This conjecture is supported by the strongly positive coefficient on the second-order term. This term turns the estimated marginal value of hilliness positive at levels of TOPOG greater than 30 contours (over twice the mean level but among the observed levels).

Many of the specifications previously employed to analyze the relationship between land prices and amenities have constrained the estimated marginal effect of the amenity to be constant. We would expect this not to be the case for two reasons. First, as developed above, the marginal effect of an amenity on land prices depends on lot size. We have attempted to account for this by putting the amenities on a per square foot of land basis. This important step adds to the explanatory power of the final specification.

Second, Spec. 6 permits the marginal value of the amenity to vary with a number of factors. One of the most important of these was the level of the amenity itself. On theoretical grounds, we would expect to find that amenities have declining marginal values, just as demand curves for other goods slope down. The coefficients on the second-degree terms in Table 4 should then all be negative. If the variable is a disamenity, higher levels of it imply lower levels of the inversely related amenity and thus greater negative valuations would be placed on further erosion of the amenity. If the variable is a good, not a bad, higher levels of it would have lower marginal values.

Instead of supporting this version of the law of demand, the estimated coefficients on the second-degree terms suggest that measuring amenity levels is an unmastered art. Most of the signs are positive and probably for good reasons. The value of living a mile closer to the CBD falls as DISCBD increases, perhaps because speeds of travel increase or because residents are more likely to be commuting to suburban job locations. On the other hand, DISCRL becomes a more costly good at greater distances.

The marginal "cost" (negative value) of a higher crime rate is estimated to decline as the rate gets higher. Once again this is counterintuitive, but may reflect either an upward reporting bias in higher-crime areas or a saturation effect, where the fear level reaches a plateau and variation in crime rates is not perceived. Similarly, perceived pollution levels and perceived damages are an unknown function of actual pollution. Thus, even if physical damage from additional pollution may be higher at higher pollution levels, additions to pollution will not be perceived beyond a certain level or their damage not fully appreciated. If so, the positive second-order term on additional pollution may be missing an actually increasing aversion to dirtier air.

Finally, the decline in the cost of hilliness as hilliness increases has already been noted and ascribed to the greater importance of aesthetic considerations in very hilly areas. It illustrates well the implication of all these estimated second-order effects that the measures of amenities used here and elsewhere are not always closely related to what the individual resident perceives the relevant amenities to be. The actual costs of commuting an additional mile depends not only on the number of miles, but also on the speed of travel, other driving conditions or transit mode comforts, and the location of the workplace. Similarly, the aesthetic gain from hilliness is not determined by the same elements of the terrain as those that affect the costs of development. However, this does not imply that the second-degree terms should be dropped. They become all the more necessary to sort out the multiple components of the independent variables. It does suggest that better measures of amenity levels are needed before more can be said about the slopes of the demand curves for the amenities.

These same issues arise in interpreting the estimated interaction effects between amenities. For example, a strong negative interaction is estimated to exist between DISCBD and POL. This could be because of authentic complementarities between these disamenities. But equally likely is the possibility that the presence of high levels of pollution in the more distant suburbs is related to the presence of another disamenity, such as a manufacturing area or highway interchange. The other amenity and land interaction terms are also subject to alternative explanations. However, as before, it is preferable to control for such measurement problems rather than leave them unaccounted for by a simpler specification.

Another set of important terms in the expanded specification are the income interaction terms. Spec. 6 permits income to shift the marginal values of the amenities by a constant amount.[9] The shift effect is presented in Table 4, row 4. If the particular amenity is a normal good (bad), higher income residents will place a greater positive (negative) value on additional amounts of it. In this case, the sign of the effect will be the same as that of the marginal value of the amenity variable, positive if a true amenity, negative if a disamenity. This is the case for all variables except POL. This also may reflect a measurement problem, if higher incomes are correlated with either different sources of the pollution or simply with the presence of air conditioning acting to reduce damages from particulate matter.

The correct sign on all the variables other than POL lends support to the importance of income as a determinant of amenity valuations. The significance of the last two terms in Spec. 6, income and income squared, further supports the notion that income is shifting the slopes, and thus the intercepts, of the bid-price functions.[10]

VI. CONCLUSION

This paper has utilized some of the implications of bid-price theory to strengthen the empirical relationship between land prices and locational amenities. The modifications of the "naive" specification have proven to be statistically important and reveal further information about the values people place on amenities. Perhaps equally important, they have brought out anomalies in the measures of amenities which would otherwise have remained hidden and unexplained. Both of these findings suggest that there is much more to be learned about how people value amenities and how their evaluations are translated into land prices.

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[9] Some further work has suggested that this income effect may be extremely nonlinear.

[10] Alternatively, income may be picking up some omitted amenity variables, as has been assumed in most previous studies.

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