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Hedonic Prices, Price Indices and Housing Markets

ALLEN C. GOODMAN [1]

Center for Metropolitan Planning and Research and Department of Politicial Economy, The Johns Hopkins University, Baltimore, Maryland 21218

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This paper extends hedonic price analysis to the formation of housing price indices measuring variation within a metropolitan area. In forming these indices fifteen submarkets, heterogeneous across time and space, are described within a short-run equilibrium model. Linear functional forms are generally rejected using a method proposed by Box and Cox. Aggregation of hedonic price coefficients into standardized units yields significantly higher housing prices in the central city than in its suburbs, as well as differential effects of structural and neighborhood improvements among submarkets.

I. INTRODUCTION

The characterization of housing services has been elusive in terms of a good with many components that may be valued independently of each other. Court [6] and later Griliches [11] introduced techniques of hedonic price analysis, in which the valuations of various components are determined implicitly through regression analysis.[2] These hedonic prices, when calculated and applied to "market basket" houses, reveal price differentials of up to twenty percent between the city and suburban submarkets of a metropolitan area. The price differentials shrink only slowly over time and disappear only in units of relatively high structural quality.

A review of the theory compares the view of hedonic prices as long-run equilibrium values of housing components, with a model considering a series of short-run equilibria in submarkets separated by time and space.

[1] I would like to thank John Quigley, Guy Orcutt, and Eric Hanushek of my doctoral dissertation committee for their assistance, and the Department of Housing and Urban Development for financial aid (Grant H-2304). Neither group is responsible for any errors that remain, nor do the views necessarily represent those of HUD.

[2] Court introduced this analysis in 1939. It appears to have remained relatively unused until Griliches [11]. For further discussion on general use and application to housing markets, see Griliches [12], Rosen [23], and Ball [2].

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Within such a framework the long-run equilibrium is seen to be a specific case subject to empirical verification. Subsequent analysis of covariance rejects hedonic prices as long-run equilibrium values, in favor of the short run model.

The theory also provides no basis for a priori determination of functional form. Alternative forms are analyzed systematically by submarkets using a method developed by Box and Cox. A joint maximization of likelihood functions is then used to determine functional form across the metropolitan area. The technique generally rejects linear forms in favor of multiplicative models.

The final section of the paper evaluates standardized bundles of housing services among submarkets according to the hedonic price coefficients estimated earlier. The results of this procedure show central city houses to be as much as twenty percent more expensive than comparable suburban houses, providing justification for such behavior as the "flight to the suburbs." The "rebundling" process also reveals the expected quality premiums for better structures or better neighborhoods. Valuations of improvements in structure are found to be greater in the suburbs than in the city. This contrasts, however, to neighborhood improvement whose value appears to be constant throughout the metropolitan area. Price convergency (between city and suburb) over the three year period in houses with substantial structural quality appears to reveal a more unified market for this type of structure than for lesser quality structures or any neighborhood category.

II. HEDONIC PRICE STRUCTURES—INTERPRETED AND REINTERPRETED

Housing has typically been analyzed as a long-lived durable good, existing in a market in long-run equilibrium. This has led to an interpretation of hedonic price coefficients as "shadow prices" reflecting streams of returns from given attributes of the house. Subsequently, such coefficients may then be inserted into models from which, given a linear budget constraint, demand relationships for housing and its attributes can be estimated.[3]

Hedonic price approaches (as noted in Griliches [10]) are based on the research strategy which asserts that a large number of models of a particular heterogeneous commodity can be comprehended in terms of a smaller number of attributes, or components. Simply stated,

$$P = f(C), \tag{1}$$

[3] The nature of long-run equilibrium is discussed by Apgar [1]. A particularly good critique of the problems underlying such an assumption is presented by Kain and Quigley [14].

in which P is the selling price of an individual house and C is a set of components that is thought to contribute to that price. The hedonic price of the ith component of set C is defined as $\partial P / \partial C_i$. There is no theoretical linkage between the functional notation and a specific functional form, although linear and log-linear forms are generally used.

The hedonic price of a given component is a reduced form measure, an interaction of supply and demand market forces; the requirements for its mapping into utility space are stringent. In particular, it is necessary to have a single market in long-run equilibrium for the valuation of a good in terms of production cost, and the valuation in terms of utility, to be equal. Many observers have noted that high conversion costs of residential capital, consumer immobility and heterogeneity of the commodity appear to violate assumptions upon which a long-run equilibrium (and the pressure for housing price uniformity implicit therein) in housing markets must be based.[4]

The possibility of spatial and temporal separation of markets is well-recognized. Kravis and Lipsey [17] note that international differences in regression coefficients for heavy engines could be expected if the various markets are isolated from each other, a useful analogy to housing stock, which is not generally mobile (and whose purchasers may be similarly immobile due to discrimination, segregation, workplace or income constraints). Straszheim [25] contends that even within the Standard Metropolitan Statistical Area (SMSA) as a whole, hedonic prices must be estimated within smaller submarkets.[5] Regarding temporal separation, there is no apparent rationale for the restriction of either relative or absolute prices of components to constant values.

It follows, then, that the relationship noted in Eq. (1) is too restrictive, imposing uniformity of coefficients across both space and time. A more general form, encompassing both long- and short-run equilibria is:

$$P_{nt} = f_{nt}(C_{1nt}, \ldots, C_{1nt}), \tag{2}$$

referring to the ith component in the nth submarket at time t. The hedonic prices determined are not necessarily long-run equilibrium supply prices, but rather a set of market prices that reflect the composition and location of existing stocks of residential capital and neighborhood components. Analysis of such price disparities can be clarified if the demand for given components in the SMSA is considered to be segmented by workplace

[4] A good discussion of these problems can be found in Ingram et al. [13, pp. 18–22]. Kain and Quigley (Chapter 2 and Appendix) consider an additive hedonic price model in which each coefficient is composed of a production cost and a quasi-rent reflecting the degree of competition in the market.

[5] Schnare and Struyk [24] find little evidence of submarket segmentation for the Boston area, however.

considerations, discrimination or search costs, for example. Such segmented demand functions for individual components interact with relatively inelastic short-run supply functions to produce varying prices among submarkets. A long-run equilibrium price is seen to be the case where $\partial P/\partial C_{1nt}$ is constant across all n and t.

Functional form of the hedonic price relationship has been conjectural in treatment. Linear functions have often been useful, following both from the notion of linear coefficients as shadow prices, and from their suitability in the estimation of demand elasticities of housing "characteristics."[6] Griliches [10] has considered a transformation proposed by Box and Cox [3] as a systematic means for choosing among a set of functional forms among which linear and log-linear are special cases.[7]

This transformation involves a search on as many as $k + 1$ elements of the vector of nonlinear parameters λ, in a relationship such that

$$\frac{Y^{\lambda_0} - 1}{\lambda_0} = \beta_0 + \sum_{1}^{k} \frac{\beta_i}{\lambda_i} (X_i^{\lambda_i} - 1) + \epsilon. \tag{3}$$

As λ_i approaches 0, the function is continuous. Moreover, both the linear and log-linear forms can be seen as special cases of this general transformation. The case to be examined involves a search on λ_0, with all other values of λ set to one.[8]

Hypotheses of varying levels of rigor can be tested. A stronger assumption would hold that the true functional form is similar to the general transformation, and that proper estimation of λ will complete the specification. Weaker statements would concern the choice among various specifications; values not significantly different from zero would lead to rejection of hypotheses of linearity, while values not significantly different from one would lead to rejection of the semi-log form.[9]

III. INDICES OF HOUSING PRICES

Although hedonic price methods were originally formulated to examine specifically the measurement of quality controlled price changes, such

[6] Referring to an analysis introduced by Lancaster [18, 19]. See also, King [15].

[7] These are by no means the only forms available. Lapham [20] considers others.

[8] To consider continuity, using l'Hôpital's Rule, differentiate the generalized function, $(Y^{\lambda} - 1)/\lambda$. Its limit is $\ln Y$ as λ approaches zero. The case noted becomes a test of linear against semi-log form. Log-log transformations have been considered, yet appear to exhibit instabilities in the maximization of the relevant likelihood function. For further explanation of the general procedure see Box and Cox [3] and Zarembka [27].

[9] A hypothesis somewhere between the two in rigor would reject both linearity and log-linearity with a value of λ significantly different from both zero and one. The general transformation using λ can be manipulated to become:

$$Y = (1 + \lambda\beta_0 + \lambda\Sigma\beta_i X_i)^{1/\lambda}$$

applications to housing analysis have been rare. This lack of activity can be linked to both the paucity of suitable data and the continuing consideration of the housing market as one in long-run equilibrium. In this section price indices are proposed as additional means for comparing housing prices among submarkets with unequal hedonic price coefficients. In addition, their combination into separate categories of structural and neighborhood bundles is useful for examining within-submarket variation of housing prices.

The general insistence on treatment of the housing market as one in long-run equilibrium has foreclosed the comparison of aggregate prices across submarkets within a metropolitan area. Such an equilibrium implies either an equality in price of a homogeneous commodity referred to as "housing services," or a similar equality in coefficients of a hedonic price structure of housing taken as a heterogeneous good.[10] It is clear from previous formulation that the long-run equilibrium nature of the hedonic price coefficients is empirically testable; their "rebundling" into a market basket house can then be used as a second test for submarket segmentation through aggregate price differences.

A number of index number problems are recognized. Composition of the market basket presents a particular dilemma because of the differing physical stocks of housing customarily available among submarkets. Also, as submarkets may be characterized as having various proximities to a central place, their comparison must account for location rent differentials. Implementation of indices thus involves use of a cross-section analogue to the "chain index" (following Gillingham [7]) in which area-wide means are used in the standardization unit, and evaluation is at a constant distance to control for location rent effects.

Intra-submarket variation in housing price can be measured with the bundle viewed as a combination of sets of *structural* and *neighborhood* components. Neighborhood effects are seen by holding the structural components (i.e., those contained within the physical bundle and surrounding lot) constant and varying the neighborhood set. This is analogous to moving a combination of structural components among neighborhoods, considering the difference in selling price as a neighborhood effect. Changes in the structural quality can be handled similarly.

As such, sets of neighborhood and structural components which might be ranked from "lesser" to "better" quality can be considered within submarkets. The analysis can be extended across submarkets to compare the relative valuations extended to improvements in housing quality in either the structural or neighborhood dimension.

[10] An example of the "housing services" approach is in Olsen [22].

IV. EMPIRICAL FINDINGS ON REGRESSION MODELS

In this section, empirical analysis of hedonic price coefficients is presented with special emphasis directed toward hypotheses concerning the independence of hedonic price structures with respect to time and/or space, and functional forms of the hedonic relationships. Application of covariance analysis to subsets of the metropolitan (entire SMSA) sample yields significant differences in coefficients across both space and time. Examination of functional forms rejects hypotheses of linearity or log-linearity in the hedonic price relationships, while preserving the results of earlier findings with regard to heterogeneity of coefficients.

The general strategy involves a sequential disaggregation of the data base, in terms of time and submarket area. Although the conceptual model is formulated in terms of temporally and spatially separate submarkets, determination of the separate nature of the coefficients is an empirical matter—hence, SMSA results are disaggregated to test the hypotheses.

The data base is a set of 1835 single family houses sold in the New Haven SMSA from 1967 through 1969. Measures of school and neighborhood quality were added by King, and socio-economic dimensions were derived from the Census Bureau's First and Fifth Count block group statistics. These neighborhood aggregation units, typically 20 to 25% of the size of a census tract, add considerable explanatory power, over the customary tract aggregation level.[11]

Analysis of regression coefficients tests for their equality across both space and time; the null hypotheses are that entire sets of coefficients are equal. Stratification of the sample by year for either the SMSA or geographically segmented submarkets leads to rejection of the null hypothesis of equality across time. Similar stratification by submarket for either the 3-year period or separate years leads to rejection of the null hypothesis of equality across space. A final extention of the disaggregation of markets (Table 1) is a nested analysis of covariance by year and submarket. The composite results confirm the finding of coefficient heterogeneity by time and area for various submarket breakdowns.[12] This leads to the rejection of hedonic price coefficients as shadow prices of components in markets that are in long-run equilibrium.[13]

[11] For more detail on the housing sample, see King [16, Chapter 3]. More information on block groups can be found in Goodman [8] and Bureau of Census [26]. One neighborhood variable that has been excluded is the property tax rate. Tests for its capitalization into housing prices, on estimated coefficients, have revealed little sensitivity in the results presented.

[12] Goodman [9] discusses methods for comparing alternative submarket breakdowns.

[13] Schnare and Struyk [24] inspect relative change in the standard error of estimate (large changes imply heterogeneity), a procedure that reduces type II statistical error. Here, subsequent rebundling of the coefficients into indices provides a second test.

TABLE 1

Nested Analysis of Covariance by Year and Submarket

Year	Degrees of freedom	Linear	Semi-log	$F_{0.01}$
1967	(76, 627)	2.553	2.090	1.47
1968	(76, 690)	3.161	2.874	1.47
1969	(76, 233)	1.515	1.638	1.53[a]
Pooled	(266, 1550)	3.565	3.064	1.28

[a] $F_{0.05} = 1.35$.

The incidences of various components in the spatial breakdown chosen imply significant supply differences across the submarkets. While garage space, bathrooms and lavatories appear to be relatively constant across submarket areas, lot size, age of house, number of rooms, and living space within houses are not. For these four structural components, analysis of variance (Table 2) indicates significant intersubmarket differences (year-to-year variation of the available stock within a submarket is not significant). Hence, changes in hedonic prices of attributes may be linked to changes or instabilities of the structure of the model, itself, rather than variations in the data base. This variation might support the inference that, while the price structure could change from year to year within a given submarket, differences among submarkets within a given year are also related to supply characteristics of the housing stock. (This might be particularly true in analysis across suburbs, with the lack of overt racial discrimination that might tend to segment the housing market between the central city and the suburbs in a demand-related manner.)

The Box and Cox procedure is applied to the 15 submarkets (five areas over 3 years) for i components:

$$\frac{1}{\lambda_j}(P^{\lambda_j} - 1) = \beta_{0j} + \sum_{1}^{k} \beta_{ij}C_{ij} + \epsilon_j \tag{4}$$

maximizing with respect to λ_j. As noted in Table 3, the hypothesis of linearity is rejected in 11 of 15 cases. The stronger hypothesis of either linearity or log-linearity is rejected in six of these cases.

Although it is possible that the functional form of each of the 15 submarkets is well-specified by the estimated value of λ_j, it is more likely (and far more statistically tractable) that there exists a single "best" value of λ for the entire metropolitan area. As the 15 submarkets are independent, the joint maximum likelihood function is the product of the individual functions:

$$L^* = \prod^{j} L_j \qquad j = 1, \ldots, 15. \tag{5}$$

TABLE 2

Analysis of Variance on Selected Components
(H_0: samples drawn from same population)

Variable	F-Statistic			
	1967	1968	1969	Pooled
SIZE	13.80	24.49	11.31	46.80
SPACE	9.28	9.75	7.77	24.11
RMS	6.93	9.37	4.15	17.44
AGE	25.75	22.47	17.48	62.73
Degrees of freedom	(4, 721)	(4, 780)	(4, 323)	(4, 1830)
$F_{0.01}$	3.36	3.36	3.41	3.34

Such a formulation yields a value for λ^* of 0.6, effectively rejecting both linear and semi-log forms for SMSA-wide calculations of hedonic price structures. Re-estimation of submarket regressions with these parameters reaffirms heterogeneity of coefficients across both temporal and spatial divisions.[14]

V. INTRAMETROPOLITAN PRICE INDICES AND THEIR INTERPRETATION

Upon the determination of suitable hedonic price regressions for each submarket, indices can be formed to determine relative prices of housing services. The comparison of standardized bundles across submarkets provides additional evidence of market segmentation across time and space, with suburban bundles generally 10 to 20% cheaper than their New Haven counterparts. SMSA-wide estimates, in contrast, approach a weighted average of suburban and central city housing prices, consistently underestimating the latter by as much as 15%.

The analysis of intra-submarket variations of structural and neighborhood quality reveals the expected premiums for improvement in each. Comparison across submarkets reveals, however, that improvements in structural quality are more highly valued in the suburbs than in the central city. Similar improvements in neighborhood quality show no systematic differential in valuation across submarkets.

The creation of price indices also allows conjecture on consumer behavior and price adjustment in the housing market. The "flight" to the suburbs is seen to be a rational reaction to the sizable difference in price

[14] I am grateful to Steve Arnold for pointing out this application of the Box and Cox procedure.

TABLE 3

Box and Cox Tests Against Null Hypotheses of Linearity
(Alt. hyp: semi-log form value of λ, as noted)

	Submarket				
	I	II	III	IV	V
1967	0.7[a]	1.2	0.0[a]	0.0[a]	0.6[a]
1968	0.6[a]	0.9	0.6[a]	0.0[a]	0.5[a]
1969	0.5[a]	0.8	0.1[a]	0.0[a]	1.1

Note: Tests performed on submarkets stratified by year. I, New Haven City; II, Western suburbs; III, Hamden; IV, Wallingford-Cheshire; and V, Eastern suburbs.
[a] If $H_0: \lambda = 1$ is rejected at 5% level.

between the city and its suburbs. Also, price differentials appear to converge slightly in all bundles over the 3 years, but reach near-equality only in structures of high physical quality, implying that the market is more unified and responds more quickly to price differentials than do the markets for units of lesser physical quality housing.

As noted earlier, crucial elements in this analysis are the choice and weighting of the components of the standard bundle. As such comparisons of price across sectors of a metropolitan region lead to difficulties analogous to those involving Paasch and Laspeyres indices in time series work, a cross-section analogue to the chain-link index, with component weights averaged among areas, is adopted. A related problem is the interpretation of a bundle composed of mean measurements of components (such as 1.24 bathrooms or 0.65 fireplaces). The option of "constructing" houses with integer weights, where appropriate, will be followed in the use of indices.

Griliches [11] notes that the construction of an index for a good analyzed with hedonic price methods, deals, in fact, with a distribution of sample means. If the standard error of estimate for a given observation is σ, and the number of houses in the sample is n, then the standard error of the average index price of the sample will be $\sigma/\sqrt{n}$. The appropriate significance test, then, for determining the differential effects upon a housing bundle is the difference between sample means.

Three separate *structures* of physical components and three separate *neighborhoods* of neighborhood components are presented in Table 4 to consider the effects of physical and neighborhood quality change. They can be roughly described as lower-middle, middle, and upper-middle class conceptions of housing and neighborhoods; a matrix of the nine possible combinations of *structure-neighborhoods* is constructed to reveal interactions among them. Analysis by geographic sector is displayed in Table 5a for two sets of indices representing New Haven (central city)

TABLE 4

Structure and Neighborhood Specifications

	SI	SII	SIII
SIZE	19,000	21,954	23,000
BRICK	No	No	No
HW	Yes	Yes	Yes
GAR	2	1	1
AGE	35	30	25
RMS	6	7	7
BATH	1	1	2
LAV	0	1	1
SPACE	1,350	1,441	1,500
FP	0	1	0
	NI	NII	NIII
BLACK	6	4	2
POOR	8	8	5
EDUC	25	30	35
TIP	Yes	No	No
SCORE	60	75	85
PCN	−0.2	0.3	0.7

Also: Constant; distance, 3.5 miles; and SPDIS.

Notes: SIZE, Lot size in square feet; BRICK, "1" if house is all brick; "0" otherwise; HW, "1" if hardwood floors; "0" otherwise; GAR, Number of covered garage spaces; AGE, Age of house in years; RMS, Number of rooms excluding bathrooms, lavatories; BATH, Number of full bathrooms; LAV, Number of lavatories; SPACE, Indoor living space in square feet; SPDIS, Space × log (distance) × 0.001; FP, Number of fireplaces; BLACK, Percentage black population; POOR, Percentage families with income less than $5,000; EDUC, Percentage of population over age 25 with 13 or more years of education; TIP, "1" if BLACK is greater than 5% and less than 15%; "0" otherwise; PCN, Principal components measure of neighborhood attitudes; Distance is in logarithms.

and its suburbs. Prices are evaluated at a distance of 3.5 miles from the CBD (corresponding roughly to New Haven's border with the suburbs) to control for location rents relative to the center of the city.[15]

The results are surprising. The general trend for prices in the late 1960's was upward and the inclusion of year dummies in a pooled model yields a positive, significant coefficient for both 1968 and 1969, yet use of separately estimated models shows insignificant price increases in many areas (indeed, declines in some submarkets) in 1968, followed by rises in 1969. Furthermore, controlling for both *structure* and *neighborhood*

[15] Sensitivity analysis to the composition of the index bundles reveals a stable relationship in the results that follow. Neither do the findings appear to be sensitive to the choice of distance for bundle valuation.

TABLE 5

Structure-Neighborhood Indices[a]
(New Haven/Suburbs)

a. Submarket estimates

		NI	NII	NIII
SI	1967	97.82/ 81.42	109.73/ 89.00	114.52/ 93.39
	1968	102.01/ 81.92	112.16/ 95.71	121.43/102.28
	1969	109.61/ 92.83	119.47/104.14	127.71/110.95
SII	1967	108.82/ 92.05	121.34/100.00	126.33/104.64
	1968	107.81/ 91.89	121.75/106.30	127.64/109.01
	1969	112.97/101.73	122.94/113.44	131.49/120.49
SIII	1967	111.73/104.26	124.26/108.65	129.29/113.40
	1968	115.50/ 95.56	129.81/110.19	135.86/117.13
	1969	111.40/110.76	121.32/122.87	129.55/130.14

b. Single market estimate

	NI	NII	NIII
SI	86.39	94.93	101.11
SII	103.06	112.22	117.66
SIII	112.18	121.64	127.26

[a] SII-NII for suburbs in 1967 of $25,028 is normalized as 100.00. For effect of neighborhood (structure) change read across (down).

the prices in New Haven are up to 20% (sometimes, more than $5000) higher than in the suburbs, although there is some indication that the differential may be diminishing from year to year.[16]

Comparison of the estimates by submarket with a single equation model (in Table 5b) reveals the latter's approximating a weighted average of all prices, that tends to understate central city prices. The differences of up to 15% imply that serious prediction errors could occur in using SMSA-wide estimates to predict prices in a given submarket.

Within submarkets, improvement of structure quality (neighborhood quality) holding neighborhood quality (structure quality) constant yields the expected premiums. In addition, inspection of Table 5a shows the price differential for structural bundles between central city and suburbs decreasing as structure quality improves. There is a lack of corresponding behavior for neighborhood change. This implies that the relative valuation

[16] For SII–NII, t-statistics on difference of means are 12.49, 12.09, and 8.87 for the 3 years ($t_{0.05} = 1.96$).

of physical improvements is greater in the suburbs than in the central city; neighborhood improvements appear to be constantly valued in both submarkets.

In view of the substantial price differentials between city and suburbs it would seem that the well-documented flight to the suburbs was a rational one. The sizable fall in the cost of housing services as well as the possibility of an expected capital gain from an "undervalued" suburban asset, could be seen to outweigh the frictions in the market such as moving and closing costs.[17] The segmented nature of the metropolitan housing market (both in demand and supply relationships), as well as the heterogeneous nature of the good (which may make explicit comparison difficult) may allow such differentials to exist and persist, even in the face of substantial mobility.[18]

Price differentials seem to disappear for SIII structures, regardless of neighborhood quality, by the third year of the sample, indicating a more unified market than for structures of lesser quality. This would imply that the market adjusts more quickly for this category of housing quality either because of better information among the buyers about the good, or because the transactions costs fall as a percentage of the price as quality improves, reducing the impact of market frictions.

That similar neighborhood improvements do not appear to decrease the differential is puzzling in this context. Perhaps the specification of neighborhood quality is incomplete without such dimensions as crime and pollution (included only marginally in the principal components measure). Assuming that both would be more prevalent in New Haven than in the suburbs, their omission would understate the price differential, reinforcing, incidentally, the explanation of movement to the suburbs. Improvement of neighborhood quality in the well-specified model, however, might narrow the differential in a manner similar to the improvement of structural quality.

CONCLUSIONS

This study appears to clarify several aspects of housing analysis using hedonic prices, with respect to market segmentation, functional form and behavior of prices within submarkets. In positing various spatially and temporally separate submarkets, covariance analysis indicates heterogeneity of coefficients. These coefficients, when rebundled with standardized housing packages, reveal significant price differences between submarkets

[17] Literature on "flight to the suburbs" includes Bradburn et al. [4], and Bradford and Kelejian [5]. Market frictions are discussed in Maisel [21].

[18] Straszheim [25] notes that households appear to have strong preferences for lot size and age of housing, in particular.

that are obscured by single market assumptions and estimation procedures.

The often used linear functional form is found to be overly restrictive. Consideration of other forms with the procedure developed by Box and Cox indicates that a multiplicative form is generally preferable. Maximization of a joint likelihood function over independent submarkets reveals the proper functional form for the SMSA as a whole.

Intrametropolitan examination of structural and neighborhood quality reveals that the relative valuation of physical improvements in housing is smaller in the central city than in the suburbs, while the relative valuation of improved neighborhoods is relatively constant. Price adjustment processes imply that markets are more unified with respect to structural than neighborhood quality, but that the process is slow and generally incomplete for the entire metropolitan housing market. Movement from city to suburb is seen to be a rational reaction to the sizable differences in price between the two submarkets.

In general, then, it appears that hedonic price methods can be applied to separate parts of metropolitan areas to measure price differences both within and among such submarkets. In that there are several well-recognized impediments to housing price uniformity related to spatial criteria, judicious subdivision of the metropolitan market reveals valuable information about price variation within the metropolitan area. Although single equation models can give serviceable answers about prices, on average, separate equations may offer more insight into the important short-run behavior of markets within the metropolitan area.

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