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Explaining Metropolitan Housing Price Differences[1]

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Housing prices differ substantially among metropolitan areas. The rent and house price indexes used here measure this variation among 54 metropolitan areas. A model of metropolitan housing price determination is presented and used to identify the sources of intermetropolitan price variation. Reduced-form equations explain close to 90% of the variation in rental prices and close to 60% of the variation in house prices.

1. INTRODUCTION

The price of housing differs substantially from city to city. Persons who move, newspapers, and government programs provide much evidence about differences in rents and house prices. *The Wall Street Journal* (March 6, 1981) provides an example of variation in house prices. In a front-page article subtitled "Why an Ohio Woman Cried," large differences are reported in the quality of housing that $180,000 buys among 6 metropolitan areas. HUD provides evidence of rent variation through its Fair Market Rents. In 1979 these rents for standard 2-bedroom rental units ranged, for example, from $347 in New York City to $221 in Louisville.[2]

Public interest in these differences is not just idle speculation. The 40% rent difference between New York and Louisville and the housing quality differences documented by the *Wall Street Journal* substantially affect real incomes. How much of these price differences is due to the immutable scarcities of land, labor, and materials? How much results from changeable features such as local development restrictions? Answers to these questions are important for evaluating policies to reduce the cost of housing and for assessing the benefits of policies that limit housing development.

In spite of wide public perception of and real interest in these differences, few economists have tried to measure them systematically or explain their causes. What professional interest there has been has focused on using

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[2]*Federal Register*, June 22, 1979, and October 12, 1979.

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existing price measures to estimate single structural parameters. De Leeuw and Ekanem [1] and Rydell [8] have used existing intermetropolitan price indexes to estimate landlord supply elasticities. Many others have used intermetropolitan price variation to estimate demand price elasticities (see review by Mayo [4]). No one has previously attempted a comprehensive measurement or explanation of these housing price differences.

We have constructed price indexes for rental housing and owner-occupied homes by applying the same hedonic index equation to consistent data from all major metropolitan areas. In this paper we report our indexes for 54 areas. We also present a model of metropolitan housing markets that we use to specify the determinants of housing prices. We then use regressions of our rent and house price indexes on the determinants of the model to explain metropolitan price differences.

The determinants of the model explain 90% of the variation in our rent index and 60% of the variation in our house price index. The immutable forces of scarce or expensive inputs coupled with differences in demand account for most of the explained variation. However, our proxy for development restrictions makes statistically significant contributions to both rent and house price differences. While more work needs to be done, particularly on house price differences and measures of development restrictions, we feel our results represent a useful first step.

In Section 2 we present a metropolitan housing market model and derive estimating equations for our price indexes. In Section 3 we present our price indexes and other data. We report our regression results in Section 4, which is followed by a concluding section.

2. THE MODEL AND ESTIMATING EQUATIONS

Our model analyzes long-run supply and demand in the entire metropolitan housing sector. The model divides the metropolitan housing sector into renter and homeowner subsectors. Each subsector is structured around markets. The renter subsector is characterized by markets for rental housing services and real estate used to provide those services. The market for rental housing services matches tenants' demand with landlords' supply of housing services. The market for real estate used in rental housing—that is, for buildings suitable for renting—represents landlords' demand and real estate developers' supply of such properties. The homeowner subsector is characterized by the market for owner-occupied, single-family homes. Households who choose to own demand houses and developers supply them.

The renter and homeowner subsectors influence each other in two ways. First, the relative price of owning compared with renting affects the number of households that choose to own and rent. Second, each subsector demands land in the urban land market where the total demand is a prime determinant of the price of urban land.

The system of equations representing these markets comprises a 12-equation model of the metropolitan housing sector. We focus our presentation on the variables that prove of interest in the reduced-form estimations.

Renter Subsector

We identify two markets in our renter subsector, one for rental housing services and one for real estate used in the production of rental housing services. In the services market, the aggregate tenant demand H depends on the price of rental housing services h relative to the price of other goods x, average tenant income YR, the number of renters NR, and demographic characteristics of renters DR. The formulation is standard and, except for the demographic variables that we discuss below, the expected influences are obvious. The metropolitan supply of rental services is also standard. The aggregate quantity supplied in the long run depends on the services price and the price of capital and operating inputs used to produce the services. A price index of operating costs u is specified in the data section. We disaggregate the price of capital into a price for properties that can be rented ar, expected appreciation in this price gr, a mortgage rate i, and real estate taxes T. Depreciation and federal tax provisions are omitted because they should be similar among areas. The demand and supply equations are written, respectively, as

$$H = \alpha(h/x, \mathrm{YR}/x, \mathrm{NR}, \mathrm{DR}) \quad (1)$$

$$H = \beta(h, u, \mathrm{ar}, \mathrm{gr}, i, T). \quad (2)$$

The price of properties that can be rented, ar, is the one explanatory variable most likely to be endogenous to the long-run equilibrium values of h and H.[3] One reason is that land is an essential input to production of properties and accessible land is inelasticly supplied.[4]

Because of the likely endogeneity of prices for rentable properties, we have included a market for such real estate. In this market landlords demand rentable properties and builders or developers supply them. The quantity of such real estate SR landlords demand is a typical derived demand for an input and as such depends on the same determinants as the services supply function. The long-run supply of real estate by builders and developers depends on the prices of real estate, land l, and nonland inputs n. Nonland inputs include building materials and construction worker wages. All determinants have their traditional effects. We write the demand

[3] The other inputs are supplied to markets larger than a single-area housing market or they depend on future changes in h and H, not their present equilibrium values.

[4] Rental property values are also probably exceptionally sensitive to short-run disequilibria in rents because of the durability of real estate. We ignore these latter influences by assuming a long enough period for real estate supply to adjust to its demand.

and supply for real estate for the rental sector, respectively, as

$$SR = \gamma_R(h, u, \text{ar}, \text{gr}, i, T) \tag{3}$$

$$SR = \delta_R(\text{ar}, l, n). \tag{4}$$

Clearly the price of land in a metropolitan area depends on the quantity of rental (and homeowner) housing produced in that market, so urban land needs to be treated endogenously as well. The contribution of the rental sector to land price determination is its demand for land used in landlords' real estate. The equation derived from supply equation (4) is

$$LR = \phi_R(\text{ar}, l, n) \tag{5}$$

where LR is the quantity of land demanded by real estate developers in the rental sector.

This purely long-run specification of the rental subsector ignores the influences of highly durable capital stocks, uneven population growth, cyclical mortgage rates, and other short-run factors. The seriousness of these omissions can be judged in part by the success or failure of the long-run model to account for variations in rent levels. The homeowner subsector developed below takes the same long-run perspective; therefore, the same criterion for judging the importance of short-run influences will apply.

Homeowner Subsector

We represent the homeowner sector by the market for owner-occupied single-family homes and by the demand for land derived from this market. Because homeowners supply themselves with housing services there is no explicit market parallel to that between tenants and landlords. Still, the demand for homeowner real estate can be viewed as the derived demand for an asset used in the production of housing services. Consequently, the demand equation for homeowner real estate parallels the combined demands for services and real estate of the renter subsector. The supply of real estate to the homeowner sector parallels its supply to the rental sector in the inputs used, but, because of the greater emphasis on single-family homes in the homeowner sector, the ways in which inputs are combined can differ. We express the demand and supply of homeowner real estate, respectively, as

$$SO = \gamma_O(\text{ao}/x, \text{YO}/x, \text{NO}, \text{DO}, u/x, T/x, i, \text{go}) \tag{6}$$

$$SO = \delta_O(\text{ao}, l, n). \tag{7}$$

Notation parallels that for the renter subsector except that owner indicators have been substituted for renter indicators.

In these equations, only the effect of operating costs on the quantity of housing demanded is ambiguous in standard theory. The ambiguity arises as follows. If in the production of housing services homeowners had no substitutability between real estate and operating inputs, a higher price for operating inputs would raise the price of housing services and thereby decrease the demand for both inputs. On the other hand, if homeowners had high substitutability between the inputs, a higher price for operating inputs would have less effect on the price of services and might actually increase the demand for real estate as it is substituted for operating inputs. Thus, the effect of operating costs on the demand for real estate is ambiguous.[5] In contrast, higher taxes, higher mortgage rates, and lower expected appreciation raise the user cost of real estate and, therefore, unambiguously reduce its demand. The remaining variables in (6) have standard demand effects.

The supply of houses to homeowner yields a derived demand for land which we express as

$$\text{LO} = \phi_{\text{O}}(\text{ao}, l, n). \tag{8}$$

Relations between Subsectors

We relate the renter and homeowner subsectors through the tenure choice of households and through the market for urban land. The fraction of households in a metropolitan area that choose to own f depends on the cost of owning relative to renting r, average income Y, the price of other goods x, and demographic characteristics D:

$$f = F(r, Y, x, D). \tag{9}$$

The cost of owning needs to be measured on an annualized basis for comparison with the cost of renting. Thus, we express the relative cost as

$$r = \text{ao}(i - \text{go} + T/\text{ao})/h. \tag{10}$$

The numerator of the right-hand side of (10) is the standard expression for the user cost of capital for homeowners except that depreciation and income-tax benefits are omitted. We omit depreciation because it is probably similar among metropolitan areas. We leave the tax effects to be picked up by income, which enters directly into the tenure equation.

Inclusion of tenure choice in the model means that the number of owners and renters and the average income and demographic characteristics of each are endogenous. The number of owners and renters depends on the total number of households in the metropolitan area N and the tenure choice f.

[5]See Muth [5] for a complete analysis.

Average incomes of owners and renters depend on the average income of all the metropolitan households Y and on which ones choose to own. Likewise, the demographics of owners and renters depend on the demographics of the entire population D and on their division into owners and renters.

Renter and homeowner subsectors are also related through the urban land market. Both subsectors contribute to the demand for urban land as specified in (5) and (8). We add a third demand, that for nonresidential land LB to arrive at an aggregate demand for land L:

$$L = \mathrm{LR} + \mathrm{LO} + \mathrm{LB}. \tag{11}$$

The supply of land to the metropolitan area depends on the prices of urban and agricultural land (l and a, respectively), geographic features restricting land availability W, and governmental restrictions on land use G:[6]

$$L = \theta(l, a, W, G). \tag{12}$$

No compilation of local land-use laws and regulations exists, so we quantify G using a measure of the ability to restrict metropolitan-wide land use. Our measure is the number of municipalities/100,000 households. Following Hamilton [2], we assume that an entire metropolitan area faces a downward sloping demand for its land. Thus, if landowners could collude to restrict land supply, they would reap higher land prices. In areas with few governments controlling most of the land, the municipalities will perceive the downward-sloping demand and will restrict land development.[7] In areas with land divided among many jurisdictions, however, each jurisdiction will perceive a horizontal demand for land and will have no incentive to restrict its development. The situation is comparable to two industries, one of which is oligopolistic and the other competitive. In the oliogopolistic case the large firms perceive the downward-sloping demand of the industry, while in the competitive case each firm sees a horizontal demand. Following Hamilton's reasoning, we expect that areas with concentrated municipal powers will have a restricted land supply and a higher price than areas with such powers widely shared.

[6]The supply also depends on the extent of the transportation network of the area. We assume, however, that the extent of the network merely reflects the area demand for housing and has no exogenous influence of its own. Our exploratory empirical analysis supported this formulation.

[7]Hamilton argues that renters will support these restrictions as well, because they also serve to limit labor movement into the area.

The Estimating Equations

We want to explain intermetropolitan variation in the price of housing services for renters and the price of real estate for homeowners. Consequently, we can confine our estimation to the reduced-form equations for h and ao instead of estimating the full system simultaneously. Derivation of the reduced-form equations from the full model would show both h and ao depending on the 14 exogenous variables of the model: a, D, G, go, gr, i, LB, N, n, T, u, W, x, and Y.

Characteristics of the data led us to modify this list for estimation. Details of the data are given in the next section; here we mention only those characteristics altering our estimating equations. To begin with, we have acceptable data for 54 metropolitan areas and wish to retain 4 or 5 observations per estimated coefficient. This limits us to 11 or 12 explanatory variables and an intercept term. Next, we uncovered no measure of nonresidential land use LB so we deleted it.[8] Our data included extensive details on demographic characteristics from which we selected two. We chose the fraction of households that are nonelderly single persons DS because such households have a strong preference for renting and, whichever tenure they choose, they also have a strong demand for housing (see Rosen [7]). We also chose the fraction of households with a black or Hispanic head DB to reflect the results of discrimination or segregation on tenure choice and the demand for housing. By expanding the demographic variables we had to make other deletions. We lacked good information on expectations of future price changes so, after some experimentation, we deleted gr and go. This left us with 12 explanatory variables in each equation plus an intercept. We made one final economy in the rental-price equation by combining average tax payment T with other operating costs u to give a cost index tu. Such a combination was not possible in the house-price equation because, as discussed for (6), taxes reduce the demand for homes while the effect of operating costs is ambiguous.

The resulting estimating equations explaining rental housing service prices h and homeowner real estate prices ao are

$$h = h(Y, N, \mathrm{DS}, \mathrm{DB}, x, i, W, G, n, a, \mathrm{tu}) \tag{13}$$

$$\mathrm{ao} = \mathrm{ao}(Y, N, \mathrm{DS}, \mathrm{DB}, x, i, W, G, n, a, T, u) \tag{14}$$

where the terms are as previously defined.

Deriving definitive conclusions about the signs of reduced-form coefficients from the structural parameters is exceedingly complex. We do not

[8] Most of the demand for nonresidential land is probably proportional to, and hence reflected by, the demand for residential land.

present such a derivation here. Instead we assign expected signs to coefficients based on the primary effects of variables in the structural equations. This procedure is far easier to follow than a formal derivation, but it may in some cases invoke restrictions on the systems beyond those specified in the structural equations.

We expect higher demand for either type of housing to raise prices for both types since land is inelastically supplied. Therefore, we expect income, population, and the fraction of households nonelderly and single to have positive coefficients. By the same reasoning the price of other goods should have a negative coefficient. We expect higher costs to lead to higher prices. Therefore, in the rental services price equation we expect positive coefficients for taxes and operating costs, mortgage rates, and construction costs. In the homeowner equation we expect higher construction costs to have a positive coefficient. Taxes and mortgage rates should have a negative coefficient on real estate price since high taxes or interest costs reduce the demand for real estate (at the same time that they increase the cost of housing services). Operating costs, as explained earlier, have an indeterminant effect on real estate prices. Finally, factors that raise the price of land in other uses or restrict its development should raise both housing services and real estate prices. Thus, agricultural land price and geographic limits on supply should have positive coefficients. Our measure of the inability of governments to restrict land development should have a negative coefficient. Racial discrimination and segregation could raise or lower area housing prices depending on the impacts on mortgage availability, house sales, and rentals. Consequently, we are primarily interested in testing whether the effect differs from zero.

In the above model we follow the traditional approach (see Mayo's survey [4]) of assuming the exogeneity of income to housing price. The assumption is debatable at the metropolitan level because higher housing prices could lead to compensating increases in income. One could separate this feedback effect from that of exogenous income influences by adding equations that specify the determinants of metropolitan income. Such an extension goes beyond the scope of this study but merits future exploration. For the present, we assume income to be exogenous and accept the risk of simultaneous equations bias in our estimated coefficients.

3. THE DATA

We selected our metropolitan sample and obtained many of our variables from the Annual Housing Surveys (AHS) of 1974–1976. The Census Bureau surveyed and released records for 18 Standard Metropolitan Statistical Areas (SMSAs) in 1974, 21 in 1975, and 20 in 1976 for a total of 59

SMSAs.[9] In three urban areas more than one SMSA was surveyed: New York, Newark, and Paterson; Anaheim and Los Angeles; Dallas and Fort Worth. We used the largest SMSA to represent the entire area and deleted the others.[10] This left us with surveys for 55 independent metropolitan areas.

The AHS collected extensive dwelling and household information about each SMSA which we compiled for several variables. Foremost among these were the price indexes for housing services for renters and real estate for homeowners. We constructed the services price index by estimating consistent "hedonic" rent equations for rented dwellings in each SMSA.[11] We then used the equations to predict rent for an identical dwelling in each SMSA. The dwelling whose rent we predicted had the average characteristics of a rental dwelling among the 59 SMSAs. We constructed our real estate price index in a parallel fashion. We estimated consistent hedonic value equations for owner-occupied houses in each SMSA and then predicted SMSA values for the average dwelling. Neither rent nor value hedonic equations performed adequately for the Honolulu SMSA so we deleted this observation. That left us with the 54 SMSAs used in estimation.[12]

Our housing service and real estate prices indexes grouped by the survey year to which they refer are listed in Table 1. Generally, rent and house price indexes are higher in larger SMSAs on the east or west coast. House prices are particularly high in California SMSAs, and the predominance of these SMSAs in the 1975 survey causes higher average house prices in 1975 than in 1976. The correlation of rent and house price indexes is 0.63.

A ranking of SMSAs from different survey years would require adjustment of all entries to a common year. Our analysis avoids such an adjustment because we measure all explanatory variables for the survey year of an SMSA.

Other variables taken primarily from the AHS are the number of households, the fraction of them nonelderly and single, the fraction headed by a black or Hispanic, the median property-tax payment, and average income per household. We adjusted the average income variable (1) by calculating

[9] The Saginaw SMSA was surveyed in 1974 but individual records were not released because of the size of the SMSA. Each AHS survey year ran from April of the named year through March of the following year.

[10] Differences in survey years between the New York area SMSAs made combinations of SMSAs difficult. In all three cases, use of the largest SMSA had little effect on the population of the area relative to other areas.

[11] Hedonic rent equations regress dwelling rent on physical and locational characteristics of the dwelling. Hedonic value equations substitute value for rent among owner-occupied dwellings. Our hedonic rent and value equations are described in Malpezzi, *et al.* [3], and our rental price index is developed in Ozanne and Thibodeau [6, Chapt. II] as PRCINDX.

[12] See Malpezzi *et al.* [6, Chapt. III] for information on the Honolulu equations.

TABLE 1
Price Indexes

1974 Survey year			1975 Survey year			1976 Survey year		
SMSA	Rents ($/mo)	House price ($)	SMSA	Rents ($/mo)	House price ($)	SMSA	Rents ($/mo)	House price ($)
Albany–Schenectady–Troy	125	25,615	Atlanta	124	33,819	Allentown–Bethlehem–Easton	141	34,383
Boston	156	32,430	Chicago	156	31,928	Baltimore	135	25,203
Dallas	115	22,530	Cincinnati	113	27,630	Birmingham	101	26,602
Detroit	130	20,648	Colorado Springs	121	27,560	Buffalo	141	24,600
Los Angeles–Long Beach	156	46,644	Columbus	109	24,263	Cleveland	133	27,316
Memphis	100	24,839	Hartford	149	37,337	Denver	138	31,775
Minneapolis–St. Paul	141	27,850	Kansas City	113	21,412	Grand Rapids	129	26,239
Orlando	126	27,110	Madison	130	30,010	Houston	147	36,566
Phoenix	119	24,426	Miami	160	39,029	Indianapolis	121	21,648
Pittsburgh	115	23,934	Milwaukee	138	24,232	Las Vegas	154	36,552
Salt Lake City	112	28,227	New Orleans	111	37,190	Louisville	114	23,546
Spokane	109	23,100	Newport News–Hampton	109	30,345	New York	187	42,872

Tacoma	112	26,012	Philadelphia	142	32,364	Oklahoma	111	31,738
Washington	150	40,837	Portland	135	24,356	Omaha	117	24,667
Wichita	101	22,258	Rochester	157	24,281	Providence–Pawtucket–Warwick	145	34,903
			San Antonio	112	26,150	Raleigh	115	29,102
			San Bernardino–Riverside–Ontario	118	37,798	Sacramento	135	32,307
			San Diego	152	45,552	St. Louis	124	24,671
			San Francisco–Oakland	176	45,879	Seattle–Everett	149	33,459
			Springfield–Chicopee–Holyoke	132	29,290			
Number of SMSAs	15	15	Number of SMSAs	20	20	Number of SMSAs	19	19
Mean	124	27,764	Mean	133	31,521	Mean	134	29,905
Standard deviation	19	7,181	Standard deviation	20	7,075	Standard deviation	19	5,640

Note: Rent indexes are predicted rents for average-quality rental unit. House price indexes are predicted market values for average-quality owner-occupied single-family house.

the average logarithm of income (under the assumption that the appropriate specification of the underlying micro demand equation is for the logarithm of income), and (2) by adjusting these SMSA incomes for the 1975 recession (under the assumption that housing demand depends on permanent income). We adjusted for the recession by inflating SMSA income in each survey year by half of the gap between aggregate US income and high employment income of the same period. The gap was largest in the 1975 survey year, as expected.[13]

For variables unavailable from the AHS we used a variety of sources. We measured geographic features with an indicator variable that assumes the value unity if the central city of an SMSA is bounded by an ocean or one of the Great Lakes. The variable is zero otherwise. To get the number of municipal governments/100,000 households we combined Census of government counts with AHS population counts. Mortgage rates come from the series by the Federal Home Loan Bank Board on effective interest rates for loans on existing homes. Construction material and labor costs come from the Boeckh Building Cost Modifier for single-family homes with stucco or siding. The price of other consumption goods is the nonhousing portion of the intermediate budget of the Bureau of Labor Statistics for a 4-person family. The budget is available for only 29 metropolitan areas in our sample. Budgets for the remaining places were imputed from other areas on the bases of SMSA size and levels in nearby SMSAs. The price of agricultural land is based on state averages collected by the US Department of Agriculture.

Finally, to measure operating costs we combined an index of wages with an index of utility costs. The wage index is an average of janitors wages and accountants earnings as reported in the Area Wage Survey of the Bureau of Labor Statistics. The utilities cost index is a weighted average of the cost of a BTU from gas, oil, and electricity. This index, for states, is constructed from US Department of Energy data. The wage and utilities indexes are combined using expenditure weights from the Consumer Price Index for maintenance and utility costs of homeowners. When property taxes are included in operating costs for renters, all three indexes are weighted by their expenditure shares in the Consumer Price Index.

Continuous variables other than percentages are transformed to their natural logarithms. Those transformed are ao, h, Y, N, x, n, a, tu, T, and u.

4. REGRESSION RESULTS

We first estimated (13) and (14) with ordinary least squares. On the supposition that unmeasured features of an SMSA would affect both price

[13]We raised the fifteen 1974 incomes 3.60%, the twenty 1975 incomes 5.28%, and the nineteen 1976 incomes 3.79%. The aggregate income data refer to household income after taxes and transfers. The data are averaged over the quarters of the AHS year.

indexes similarly, we checked for a correlation of the residuals of the two estimated equations. The correlation was 0.52 and significantly above zero. When residuals of separate equations are related, more efficient estimates can be obtained by using this information. Thus, for the results reported in this chapter, we reestimated (13) and (14) with Zellner's [10] seemingly unrelated regressions technique.

Besides their correlation between equations, the ordinary least-squares residuals showed no evidence of model misspecification. In both equations the residuals were clustered about zero and almost evenly split between positive and negative values. No residuals were outliers as defined by the inner fence (Tukey [9]).

The seemingly unrelated regression results appear in Table 2. They show we were much more successful in explaining variation in the rent index than in the real estate price index. Eighty-eight percent of the rent index variation was explained while only 58% of the real estate price variation was explained. The two equations had a combined weighted R^2 of 0.82.

The relative success of the rent-index equation also was reflected in the signs and t statistics of the 11 individual coefficients. Seven rent-equation coefficients had the predicted sign and were statistically significant at the 10% level or better. The one variable in the rent equation about which we had no prior sign prediction, the fraction of minority households, was negative and significant. The other three coefficients had unexpected signs but only the one for the price of other goods was statistically significant.

In the real estate price equation only three coefficients had the expected sign and were statistically significant at the 10% level or better. The coefficients of the other 9 variables were no larger than their standard errors. Four of these had unexpected signs and 2 had no a priori expectation about sign.

The most consistent finding was that dispersion of municipal powers lowers the price of housing. The coefficient of G was the same size and statistically significant in both equations. A 1 standard deviation increase in the number of municipalities/100,000 households was estimated to lower the rent and the real estate price indexes 2.6%.

Evidence was also shown in both equations that higher demand leads to higher prices, which suggests inelasticity in the supply of housing. In the rent equation higher incomes, more households, and a higher proportion of nonelderly single households raised the rent index. In the real estate price equation only a higher proportion of nonelderly single households raised the price of real estate, but the effect was large and very significant.

The especially strong result for the fraction nonelderly and single in the homeowner equation is puzzling. We had expected the fraction nonelderly and single households to exert a stronger influence on the rental price because such households have a stronger current demand for rental housing.

TABLE 2

Seemingly Unrelated Regression Results

Independent variable	Dependent variable	
	Rent index	Real estate price index
Income (Y)	0.25	−0.12
	2.59	−0.40
Households (N)	0.04	−0.01
	2.85	−0.25
Nonelderly single (DS)	1.64	4.65
	3.65	3.65
Black or Hispanic (DB)	−0.23	0.21
	−2.46	0.68
Nonhousing price (x)	−0.53	−0.50
	−1.80	−0.54
Mortgage rate (i)	−0.02	0.10
	−0.64	1.09
Ocean or lake (W)	0.04	0.01
	1.91	0.18
Municipalities/N (G)	−0.0034	−0.0035
	−2.89	−2.42
Construction costs (n)	0.43	0.49
	2.65	1.01
Price, farm land (a)	−0.02	0.09
	−1.25	1.96
Taxes, wages, utilities (tu)	0.42	
	7.20	
Taxes (T)		0.02
		0.24
Wages, utilities (u)		0.11
		0.62
Intercept	6.74	13.79
	2.82	1.94
Number of observations		54
Weighted R^2 for system		.82
Explained variation by equation		
Rent index		.88
Real estate price index		.58

Note: Coefficients followed by t statistics are listed for independent variables. Explained variation is calculated as the ratio of predicted to actual sum of squares.

Apparently the variable is picking up some other influence in the house-price equation. We speculate that expectations may be that other influence. Nonelderly single persons are the most likely element in the population to move among metropolitan areas and presumably would collect in greater numbers in places with expanding employment opportunities. This expansion could create expectations of higher future demand and price. That expectation would be capitalized in house prices but not rents, which is consistent with the greater influence of our variable in the real estate price equation. We tried to test the expectations hypothesis directly by including several measures of past population growth rates and past price inflation, but none proved successful.

Three of 5 input cost variables have positive and significant influences on the rental price index. Taxes and operating costs, construction costs, and water barriers all contribute positively to rents. Mortgage rates do not, but mortgage rates show little variation geographically. The price of agricultural land has an insignificant influence, possibly because rental housing does not tend to be located near the urban fringe nor use land extensively. Owner-occupied homes are more likely to be near the fringe and, of course, use land more extensively. The price of agricultural land has a positive and significant effect on the real estate price index.

5. CONCLUSIONS

We have succeeded in explaining most of the variation in our intermetropolitan rent index. Long-run supply and demand factors contribute heavily to that explanation. Although not as important quantitatively, a proxy for development restrictions has proven to contribute to rent (and house price) differences. Because of the long-run nature of our model, we conclude that short-run disequilibria—as might be reflected in abnormal vacancy rates or population change—have little effect on metropolitan price differences. Rydell [8], who tests for short-run rental price effects both with our rent index and in the Housing Allowance Supply Experiment, also finds little disequilibrium effect on interarea rent differences.

We have not succeeded nearly so well at explaining intermetropolitan differences in real estate prices. The failure of the factors that explained rent differences to explain house price differences leaves us uncertain as to whether we have mismeasured real estate prices or inadequately modeled their determinants. There are reasons to suspect both.

Our measurement of real estate price differences probably has more noise in it than does our rent index. Homeowners do not have as precise an idea of the market value of their homes as renters do of their rent. Furthermore, the AHS only reports value by category and in several SMSAs the categories are poorly matched to the distribution of values. As a result, our hedonic equations for homeowners typically had larger standard errors and smaller

R^2 than the rent equations and this in turn led to less precise predicted values for our real estate price index.

In addition to the measurement problem, our model may have been less complete for house prices than for rents. Expectations about future market conditions are more important for current real estate prices than current rents, and may have been particularly important in the 1974–1976 years when inflation was accelerating. We failed to clearly identify an expectations effect.

Our model also assumed a unified metropolitan housing market. That may be too gross a simplification for homeowners. Conditions in moderate income or inner city submarkets could differ substantially from those in higher income or suburban submarkets. Such market segmentation could lead our area-wide index to mismeasure prices for submarkets and our model to misdiagnose intermetropolitan differences.

We have begun the process of quantifying and explaining intermetropolitan housing price differences. Clearly more work needs to be done on house prices. Another area that appears fruitful to examine because of our findings is the influence of local development controls. Simultaneity between income and housing prices could also be explored. Extensions of our methods should be useful for addressing these and other issues.

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