Patterns and Determinants of Metropolitan House Prices, 1977 to 1991

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Local real house prices have exhibited substantial volatility in the United States in recent years. In virtually all of the widely dispersed selection of 30 cities in this paper, real prices increased by over 10 percent and decreased by more than 5 percent in individual years during the period from 1977 to 1991. In fact, one-half of the cities experienced real price increases above 15 percent and one-third real decreases greater than 7.5 percent.

Swings in regional house prices clearly mimic regional economic cycles. Between 1977 and 1980, the average real appreciation in 11 western cities was 27 percent; between 1980 and 1983, real prices rose by 17 percent in three New England cities, but fell by 12 percent in nine Rustbelt cities. Real prices rose by a full 78 percent in the same three New England cities between 1983 and 1987, but fell by 35 percent in Houston. And between 1987 and 1991, real prices fell by 17 percent in New England and 25 percent in Dallas, but rose by 32 percent in the West (although five of the 10 California cities studied have probably experienced real price declines of close to 10 percent since the middle of 1990).

For a wide array of business and policy reasons, it is important to understand the extent to which regional cycles of changes in real house prices are systematically related to economic cycles. To date, empirical studies have not resolved this question (Abraham 1989; Capozza and

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Schwann 1989; Case and Shiller 1990; Poterba 1991). These papers have focused on other issues, and, it seems, the authors have been discouraged by their generally poor statistical fits.

A common theme in popular explanations of real house price changes involves overshooting followed by reversal. For example, a thoughtful "event study" of the recent Boston experience by Case (1991) concluded that the local cycle in real estate values drove the employment cycle to extreme heights and then depths. Seattle's sharp reversal in the period from 1981 to 1983, the Northeast's decline since 1988, and California's current reversal seem consistent with this theme. When this evidence is combined with that of an earlier Case-Shiller study (1988), one is left with the impression that "speculation"—a force that moves prices beyond what economic trends justify—was responsible for the extreme run-ups in real prices and subsequent busts. If this is the case, economic modeling would contribute little to understanding real house price changes.

This paper seeks to analyze and explain real house price movements in metropolitan areas during the 1980s, undaunted by statistical fits that are less than spectacular. The source for metropolitan price data is the Freddie Mac repeat-sale data base (Abraham and Schauman 1991). The Appendix discusses the construction of this price series.

The first section begins with the simple identity that house value is the sum of structure and land values, and illustrates that construction costs and land values can, in fact, explain a significant amount of the variation in real house prices over five-year periods. The extended framework, which draws heavily on Capozza and Helsley's (1989, 1990) modeling of real land prices, is described in the following section. The primary determinants of appreciation in real house prices are seen to be the rate of change in employment, real income growth, real construction cost inflation, and changes in real after-tax interest rates.

The model then is tested with data from 29 cities over the period from 1979 to 1991. While all the model variables work as expected, with substantial statistical significance, the empirical estimates are not as stable across areas and over time as the authors would like. Nonetheless, the next section illustrates that the model can explain a significant portion of the price variation described above, at least for the cities in the Upper Midwest and the Southeast. The major driving forces have been growth in employment and in real income (per adult). A concluding section draws together the paper's findings and provides some suggestions for future research.

Preliminary Findings

House prices are analyzed for 30 metropolitan areas, using data drawn from the Freddie Mac repeat transaction data base. This represents the maximum number of areas with sufficient house sales to compute indexes for the period from 1977 to 1991 (and even here a few adjacent years in the early 1980s had to be "smoothed"). This brief introduction describes the data and reports on results of some preliminary five-year regressions.

The Data

Table 1 presents growth rates in nominal house prices in 30 metropolitan statistical areas (MSAs) for selected periods between 1977 and 1991. The data are averages during the year; thus, the change in the 1977–80 period, for example, should be interpreted as the change from the middle of 1977 to the middle of 1980. The 30 areas in the table have been grouped into the West (10 California areas plus Seattle), the Midwest (11), and the East (eight). These three areas are then subdivided into their northern and southern parts. At the bottom of the table is the national consumer price index, cleansed of its mismeasurement of homeowner shelter costs (the CPIU-X1 index).

Northern and Southern California exhibited quite similar appreciation rates, while rates in the East showed modest dispersion, with the northern areas stronger in the early 1980s and the southern areas stronger later in the decade. In contrast, the Midwest exhibited much diversity. House prices in the two Texas cities appreciated at an annual rate nearly 5 percentage points faster than prices in the Upper Midwest in the 1977–83 period and over 5 percentage points slower in the 1983–91 period. Annual appreciation rates in Dallas and Houston even differed from each other by about 5 percentage points in three of the four periods, and individual Upper Midwest cities had appreciation rates that differed by more than 6 percentage points in three of the four periods.

Viewed over the entire 15-year period, New England and the West are the clear winners, averaging 10 percent annual appreciation (versus 5.6 percent annual appreciation in the consumer price index). However, appreciation rates varied widely between the two coasts during subperiods. The West had far and away the greatest gains in the first and last periods, while New England was the clear leader in the middle two periods and was the worst in the nation from 1987 to 1991. The rates for the two areas may be converging, however. In the 1990–91 period, the four MSAs with the greatest nominal deflation were Boston, Nassau-Suffolk, San Francisco, and San Jose, the rates ranging from −7.6 percent to −4.0 percent.

Table 1
Appreciation of Nominal House Prices[a] in Selected Metropolitan Areas and Time Periods
Annualized Percent Change

Area	1977–80	1980–83	1983–87	1987–91	1977–91
EAST					
Northeast	12.0	11.7	19.3	.2	10.4
Boston	14.3	11.0	20.0	−.3	10.8
Nassau-Suffolk	9.1	17.1	18.7	.4	10.8
Newark	12.8	7.1	19.2	.5	9.6
Southeast	11.5	3.8	6.3	5.8	6.7
Atlanta	10.9	3.7	6.0	2.3	5.5
Baltimore	10.5	3.7	7.2	8.2	7.4
Charlotte	13.9	4.0	6.4	4.8	7.0
Richmond	9.3	3.7	5.0	5.3	5.7
Washington, D.C.	12.8	3.8	6.8	8.6	7.9
MIDWEST					
Upper Midwest	10.7	1.9	4.6	5.1	5.4
Chicago	8.1	2.1	6.9	7.6	6.3
Cincinnati	10.2	1.1	4.0	6.0	5.2
Cleveland	7.1	.8	3.9	7.0	4.8
Columbus	9.8	1.7	4.5	5.5	5.3
Detroit	14.3	−1.8	6.4	7.4	6.5
Kansas City	12.9	1.6	3.5	1.3	4.4
Louisville	9.9	4.4	2.7	4.7	5.2
Minneapolis	14.1	2.7	4.8	3.5	5.9
St. Louis	9.8	4.4	5.2	2.5	5.2
Texas	15.5	6.5	−2.5	−.5	3.6
Dallas	18.3	5.4	3.1	−2.9	4.9
Houston	12.8	7.7	−8.0	2.0	2.4
WEST					
North	19.3	3.0	5.9	12.5	9.8
Oakland	18.9	3.3	7.1	11.2	9.8
Sacramento	19.8	2.5	4.3	13.7	9.7
San Francisco	18.5	3.6	8.1	12.6	10.5
San Jose	18.2	4.0	7.3	12.0	10.2
Santa Rosa	19.9	3.1	5.2	14.5	10.4
Seattle	23.7	.4	4.0	11.6	9.3
Stockton	16.3	3.9	5.0	11.6	9.0
South	17.6	3.5	5.1	11.8	9.2
Anaheim	16.0	5.4	4.6	11.6	9.1
Los Angeles	19.5	3.7	6.3	13.1	10.4
Riverside—SB	17.5	2.9	3.9	11.1	8.5
San Diego	17.4	2.1	5.5	11.2	8.8
Addendum: Change in U.S. Consumer Prices (CPIU-X1 Index)	9.2	6.6	3.3	4.6	5.6

[a]Average prices during the year; the 1977–80 period, for example, should be interpreted as the middle of 1977 to the middle of 1980.

Source: Federal Home Loan Mortgage Corporation repeat sales data base; U.S. Bureau of the Census.

Overall appreciation rates for the cities in the Midwest and Southeast ranged from 4.4 percent to 7.9 percent, with the exception of Houston, which appreciated at a rate of only 2.4 percent. These generally low rates mask some especially dismal performances over selected subperiods. The clearest loser was Houston, where *nominal* prices fell by a cumulative 37.5 percent between 1983 and 1988. Dallas, which had an enormous appreciation from 1977 to 1980, suffered a 20 percent cumulative nominal price decline between 1986 and 1990. Northern areas also did poorly. The two Lake Erie cities, Cleveland and Detroit, experienced no nominal increase between 1979 and 1984, a period when the consumer price index rose by one-third.

Table 2 presents appreciation rates calculated in real terms, using local consumer price indices (CPIs) net of shelter as deflators. Also, for the Midwest cities only, the first two periods are partitioned at 1979, not 1980, reflecting the fact that real house appreciation turned negative a year earlier in that region than in the rest of the country. The interpretation of these data is quite similar to that of Table 1. The West did incredibly well in the first and last periods, appreciating at roughly 7.5 percent per year in real terms. The Northeast did remarkably well in the middle two periods, experiencing 5 percent real growth in the 1980–83 period when the rest of the country was undergoing real price declines, and a remarkable 15 percent in the period from 1983 to 1987. Real prices fell by 5 percent in the Texas cities during the last two periods (with especially large declines in Houston in the first and in Dallas in the second), but rose by 9 percent from 1977 to 1979. The Upper Midwest had strong (6 percent) real appreciation in the late 1970s, but real prices fell by almost 5 percent annually throughout the period from 1979 to 1983.

Results of Five-Year Regressions

By definition, the value or price of a "house" is the sum of the values of the structure and the land. Further, the value of an existing structure typically is close to its replacement cost. When values of existing properties rise above replacement cost, new construction accelerates, raising replacement cost and eventually lowering existing values as the additional supply comes on line. Values below replacement cost reduce new construction, eliciting the opposite responses. Thus, a construction cost index and an accurate land value index might be expected to largely explain house prices.

Poterba (1991) tested the importance of land values to house prices by regressing five-year changes in real median house prices (National Association of Realtors or NAR) on five-year changes in estimates of the real values of an "improved, 10,000 square-foot lot" for 29 city observations, from 1980 to 1985 and 1985 to 1990 (Black 1990). The estimated

Table 2
Appreciation of Real House Prices[a] for Selected Metropolitan Areas and Time Periods
Annualized Percent Change

Area	1977–80	1980–83	1983–87	1987–91	1977–91
EAST					
Northeast	3.1	5.3	15.5	−4.5	4.7
Boston	4.7	4.8	16.1	−5.5	4.8
Nassau-Suffolk	.6	10.3	15.0	−4.0	5.2
Newark	4.1	.8	15.5	−4.0	4.1
Southeast	2.2	−2.4	3.1	1.2	1.2
Atlanta	1.7	−2.5	2.7	−2.2	−.1
Baltimore	1.1	−2.2	4.2	3.5	1.9
Charlotte	4.6	−2.4	3.2	.3	1.4
Richmond	.4	−2.7	1.8	.7	.2
Washington, D.C.	3.3	−2.1	3.5	3.6	2.3
MIDWEST (1977–79, 1979–83)					
Upper Midwest	6.0	−4.8	2.1	.7	.2
Chicago	3.0	−4.9	3.9	3.1	1.0
Cincinnati	5.6	−5.3	1.6	1.8	.2
Cleveland	2.0	−6.4	1.5	2.4	−.5
Columbus	3.2	−4.0	2.0	1.1	.2
Detroit	10.5	−7.1	3.8	2.8	1.2
Kansas City	7.3	−4.0	.8	−2.8	−.7
Louisville	4.0	−3.8	.8	.2	−.3
Minneapolis	10.4	−3.1	1.6	−1.0	.7
St. Louis	8.2	−4.3	2.7	−1.8	.1
Texas	8.8	−1.0	−5.1	−4.5	−1.9
Dallas	11.4	−.8	−.2	−7.0	−.8
Houston	6.2	−1.1	−10.0	−2.1	−3.0
WEST					
North	8.6	−3.0	2.9	7.6	4.1
Oakland	7.7	−2.6	4.0	6.4	4.0
Sacramento	9.6	−3.5	1.4	8.5	4.0
San Francisco	7.4	−2.3	5.0	7.7	4.7
San Jose	7.1	−1.9	4.2	7.1	4.3
Santa Rosa	8.7	−2.8	2.1	9.6	4.5
Seattle	13.2	−5.5	1.9	6.8	3.9
Stockton	6.8	−2.2	1.7	7.1	3.4
South	7.4	−2.5	1.9	6.5	3.4
Anaheim	5.8	−.7	1.3	6.4	3.3
Los Angeles	9.1	−2.3	3.1	7.9	4.5
Riverside—SB	7.2	−3.0	.7	6.0	2.7
San Diego	7.4	−3.9	2.4	5.7	3.0

[a]Prices deflated using local CPIs net of shelter. For other notes and sources, see Table 1.

Table 3
Explaining Five-Year Changes in Real House Prices[a]

Equation	3.1	3.2	3.3	3.4	3.5	3.6
Constant	−.045	−.098	.107		−.057	−.023
	(−1.8)	(−3.5)	(2.0)		(−.8)	(−.3)
Change in Real Land Costs	.166	.409	.328	.384	.281	.128
	(1.9)	(4.9)	(4.6)	(5.6)	(2.6)	(1.2)
Change in Real Construction Costs			2.361	1.356	2.104	.098
			(4.3)	(5.5)	(2.6)	(.1)
R^2	.10	.42	.63	.58	.52	.10
Number of Observations	33	35	35	35	17	17

[a]Both the dependent variable and the real construction cost variable are lowered by 1 percent annually to account for possible upward biases from sample selection and home improvements.

coefficient on land value was 0.29, and the R-squared was 0.27. Poterba concluded that, while statistically significant, land prices do not tell much of the story about metropolitan variation in house prices. Of course, the "improved" lot values are those of land on the peripheries of the metropolitan areas, and likely would not adequately reflect how the land under "prime, close-in" suburban houses is valued. That is, land "not mattering enough" in this equation does not necessarily mean that land, appropriately measured, does not matter enough.

This study has attempted to duplicate Poterba's results, but without success. As can be seen in Table 3, the land coefficient is only 0.17 and the R-squared but 0.10 (equation 3.1). Two data differences may be involved. First, this study found 33, not 29, city observations where data are available on both NAR median house prices and Urban Land Institute land prices. Second, the prices are deflated using local CPIs less shelter; Poterba does not discuss his deflators.

This paper reports similar equations using changes in real construction costs, as well as real land values, as regressors to explain real appreciation in the repeat-sale house price series. In order to use as large a data set as possible, five-year appreciation rates were computed for all the metropolitan areas in which Black reports land values, even when "reasonable" data for the full 1977–91 period were not available. While this paper's basic annual data set for 1977 to 1991 includes only 13 of Black's 30 areas, reasonable data could be computed for 16 areas for the 1980–85 period and 19 areas for 1985 to 1990, yielding 35 observations.

For a general construction cost measure, this study uses the National Income and Product Accounts (NIPA) residential deflator, which is really the Census Bureau deflator for new houses excluding the value of the lot, and not an index for both multifamily and single-family construction. To obtain city-specific cost estimates, the general index was multiplied by the appropriate R.S. Means Company city index adjustment factor. The R.S. Means cost survey is applicable for industrial and commercial construction projects. Using the NIPA residential deflator instead of the Means national index makes a difference. The real residential deflator fell by 6 percent in the period from 1980 to 1985 and was constant in the 1985 to 1990 span. In contrast, the real Means index was flat in the earlier period and fell by 6 percent in the later one.

These results are also reported in Table 3. In all these regressions, the repeat-sales indices are reduced by 1 percentage point annually to account for possible upward biases from sample selection and home improvements.[1] The growth in construction costs was also reduced by 1 percentage point annually, permitting the replacement cost measure to reflect depreciation in the structure. These adjustments affect only the constant term.

Equation 3.2 uses only real land inflation as a regressor. Both the coefficient on real land costs and the R-squared are about 0.4. When the change in real construction costs is added (equation 3.3), the R-squared jumps to 0.63. The cost coefficient is three times a plausible size. When the constant term is constrained to zero, the cost coefficient drops to a value insignificantly different from unity (equation 3.4). Especially in light of concerns regarding the likely location of the land at the periphery of the metropolitan area, it can be concluded that construction and land costs explain a large proportion of house price changes.

The last two equations in Table 3 are run for the 17 data points common to both this study's data set and the NAR data set. Using Freddie Mac data, coefficients (except for the constant) similar to those in equation 3.3 are obtained, and the R-squared is 0.52 (equation 3.5). With NAR data (equation 3.6), the R-squared is only 0.10, and no variables are statistically different from zero. At a minimum, these results suggest substantial superiority of the Freddie Mac repeat-sale data over the NAR median price data.

Modeling Metropolitan House Prices

Assuming that movement in the value of structures can be captured with movements in a construction cost index, the challenge is to explain land values. The urban economics literature offers a framework for doing this, specifically Capozza and Helsley (1989, 1990). In their first paper, they derive real land value as the sum of four components: the real value of agricultural land rent, the cost of developing the land for

[1] See Abraham (1990), Abraham and Schauman (1991), and Peek and Wilcox (1991a) for discussions of these issues.

urban use, the value of "accessibility," and the value of expected future real rent increases. The first component introduces the real after-tax discount rate (R), which converts a constant real rental stream into a value equivalent. The value of accessibility is greatest at the center of the city and increases with the size of the city, introducing the number of households (H) and real transportation costs per unit of distance (T) as determinants of metropolitan land values. Lastly, the "growth premium" owing to increases in expected future rent depends on expectations of future household growth. Capozza and Helsley's equation (24), which expresses the average value of developed land in a city, can be summarized as

$$P = P(\overset{+}{H},\overset{+}{T},\overset{+}{h},\overset{-}{R},\overset{-}{hR}), \tag{1}$$

where h is the expected rate of household growth.

Because Capozza and Helsley assume that the consumption of land per household is fixed, real income does not appear in (1). Allowing consumption of land to rise with real income would make the city boundary dependent on real income; higher real income would raise the accessibility premium and thus land values. Allowing consumption of land to change in response to transportation costs would dampen the price response changes in these costs. While higher transportation costs would immediately raise real land prices (the gradient for land would steepen), as people demanded less land, real prices would revert toward their initial values (the city radius would shrink).

Capozza and Helsley (1990) switch gears somewhat. Population becomes endogenous (migration is costless), and real income growth is introduced. Because consumption of both land and the composite nonhousing good are assumed to be fixed, all real income changes are translated into real rent changes via the budget constraint. A relationship like that expressed in Equation (1) is shown to hold, except that households and expected household growth are replaced with real income and expected real income growth. Capozza and Helsley also introduce uncertainty and argue that uncertainty, and the irreversibility of development, slow development and thus raise the value of developed land if the boundary of the urban area is exogenous. However, with the boundary endogenous, the price of urban land is unaffected by uncertainty. Proxies for uncertainty should thus be incorporated, but only for areas with restricted boundaries (for example, cities bounded by water or mountains).

This paper draws on both of these frameworks and includes the replacement cost value of the structure, because the issue addressed here is the price of homes, not land. For the household and real income per household variables, employment and real income per working-age

(25 to 64) adult are used (E and Y), and construction costs are denoted by C. The equation in percentage-rate-of-change form is:

$$p = \overset{+++++-}{\phi(c,e,y,\dot{e},\dot{y},r)}, \tag{2}$$

where lower-case letters refer to unexpected percentage changes in upper-case variables. Note that the equation does not include a transportation variable or a variable for a change in uncertainty (which would be relevant only for bounded cities). Preliminary testing did not yield promising results for transportation costs.

Earlier Studies

Equation (2) above can be compared with earlier empirical work. Capozza and Schwann (1989) have tested the Capozza-Helsley model with Canadian data from 20 areas over the 1969/1975 to 1984 period. The price level of newly constructed houses was significantly and positively related to the number of households, to an estimate of expected housing completions, and to the nominal interest rate. The level was significantly and negatively related to the real pretax interest rate and a time trend. Because newly constructed houses are generally on peripheral land, the urban land model would not be expected to work as well for new as for existing houses.

Poterba (1991) analyzed real appreciation in the median (NAR) house price in 39 cities over the period from 1980 to 1989. Of the variables used in this study's model, he used construction costs and real income per capita. Because he used year dummy variables, no user cost measure was employed. Peek and Wilcox (1991a) analyzed a variety of national real house price series over the 1950–89 period. Real construction costs, adjusted real income per adjusted household (see their paper for the adjustments), the user cost, and the unemployment rate were significant in their preferred equation. Using 18 city data points from the 1982–85 period, Hendershott and Thibodeau (1990) found real NAR prices to be positively related to real income and negatively related to the extent to which area growth is restricted by water.

Mankiw and Weil (1989) found an age-composition variable to have a large influence on the real U.S. residential construction deflator over the 1947–89 period. Poterba tested their national variable in his equations, and it entered insignificantly with the unexpected sign. This is not surprising, because Hendershott (1991) has shown that the Mankiw-Weil relationship did not hold in the 1970s and 1980s, the period Poterba studied.[2] Peek and Wilcox found a significant negative relationship between real house prices and the ratio of population aged 20 to 29 and 30 to 54.[3] Demographic influences beyond the employment and real income variables used here are not supported by the theoretical model, however.

Case and Shiller (1989) investigated real price changes in four cities over the 1970–86 period. They find a significant positive relationship between current real appreciation and real appreciation lagged one year, the coefficient being about one-third. In a follow-up study (1990), they tested a variety of other variables and found that real income growth, the growth in population aged 25 to 44, and the ratio of construction costs to prices had some explanatory power.

Empirical Proxies

The real (adjusted for local general inflation) house price and construction cost series were described above. The local CPIs net of shelter are from Data Resources, Inc./McGraw Hill. Employment data and population aged 25 to 64 are from Regional Financial Associates. Because no employment data were available for Seattle prior to 1985, this city has been deleted from the sample. Income data are from the Bureau of Economic Analysis, U.S. Department of Commerce. Because the 1991 MSA income and population estimates are not yet available, the WEFA Group forecasts are used to estimate these numbers. The general deflator is the CPIU-X1, the national consumer price index purged of the mismeasurement caused by rapid increases in mortgage rates in the late 1970s and early 1980s (U.S. Bureau of the Census 1991).

Two formulations of the real after-tax interest rate are tested. The first takes a longer-term (or fixed-rate mortgage, FRM) approach. The calculations use the seven-year Treasury bond rate (excluding the values of the call and default premiums built into the FRM rate) for the basic financing rate, an average of the rate of change in the national CPI over the past five years for expected inflation, and Poterba's marginal tax rate for households with real adjusted gross income of $30,000 in 1990. The second formulation takes a short-term (or adjustable rate mortgage, ARM) approach. The one-year Treasury bill rate is used for the financing rate, and the previous year's national rate of appreciation in the CPI proxies for expected inflation.

Deviations of local rates of expected appreciation in house prices

[2] See the January 1992 issue of *Regional Science and Urban Economics* for four critiques of Mankiw and Weil and their reply.

[3] See their follow-up paper (Peek and Wilcox 1991b) for a detailed explanation of the population ratio and an explanation of why the aging of the baby-boomers should raise, not lower, real house prices in the 1990s.

from the national rate of inflation are presumably captured by unexpected changes in the employment and real income growth variables. Unexpected changes are proxied by observed changes. Alternatively, these deviations could be estimated directly as functions of past general and local appreciation rates.

Say that the correct specification of the real after-tax interest rate is

$$R = (1 - \tau)i - [wpn + (1 - w)pl],$$

where pn is the expected national inflation rate, pl the expected local house price inflation rate, and w the weight given to the national rate. This expression can be rewritten as

$$R = [(1 - \tau)i - pn] + (1 - w)(pn - pl).$$

If the bracketed first term (the real after-tax interest rate using the expected national inflation rate) and (pn − pl) are included as regressors, and estimated coefficients of a and b, respectively, are obtained, 1 − w would be computed as b/a.

Metropolitan Results

The results are reported in three parts. First, estimates for the full 29-city sample are provided. Then the paper discusses results for a geographical partitioning of the data: the Northeast, Texas, and West (15 cities) versus the Southeast and Upper Midwest (14 cities). Finally, results are reported for the 1979–82, 1983–87, and 1987–91 cycles. Note that the 1982–83 change has been deleted from the sample because the boundaries defining the metropolitan areas were expanded in that year, creating a spike in employment growth. The purpose of the subsample estimates is to determine whether the results are robust across space and time.

The regressions were estimated using generalized least squares for pooled time series cross-sectional data. The technique is described in Kmenta (1971, pp. 508–12) and implemented using SHAZAM (White and others 1990). Heteroskedasticity is permitted across cities by a two-step procedure that estimates an ordinary least squares (OLS) regression, transforms each variable by the estimated standard error, and then runs a second OLS regression. This procedure was followed in all reported regressions.

In selected regressions, individual cities are allowed to have nonscalar covariance matrices and separate autoregressive parameters. This requires two transformations before the final OLS estimation, as described in Kmenta. Even with the autoregressive correction, the first observation is kept. The covariance matrix of the complete regression is

Table 4
Estimates for the Full 29-City Sample

Equation	4.1	4.2	4.3	4.4	4.5	4.6
Constant	−.008 (−2.5)	−.010 (−2.8)	−.006 (−1.7)	−.007 (−2.2)	−.006 (−2.1)	−.001 (−.4)
Real Construction Cost Inflation	.541 (4.4)	.581 (4.7)	.552 (4.6)	.468 (4.2)	.457 (4.2)	.579 (5.7)
Employment Growth	.515 (4.2)	.465 (3.9)	.496 (4.2)	.342 (3.1)	.313 (3.2)	.367 (3.6)
Real Income Growth	.835 (5.2)	.866 (5.5)	.603 (3.8)	.581 (4.0)	.565 (4.4)	.433 (3.3)
Change in Real After-Tax Interest Rate						
Seven-Year	−.604 (−2.9)					
One-Year		−.502 (−3.0)	−.578 (−3.4)	−.542 (−3.5)	−.593 (−4.4)	−.606 (−5.5)
Change in Employment Growth	−.158 (−1.6)	−.113 (−1.1)	−.144 (−1.3)	−.061 (−.6)		
Change in Real Income Growth	−.556 (−3.7)	−.520 (−3.4)	−.384 (−2.5)	−.078 (−.5)		
Change in Local Price Deviation			−.230 (−4.8)	−.076 (−1.5)	−.072 (−1.5)	−.172 (−4.6)
Lagged Real Appreciation				.392 (7.9)	.402 (8.7)	
R^2	.39	.39	.43	.53	.54	.38
Number of Observations	319	319	319	319	319	319

therefore assumed to be block diagonal. Estimation of Kmenta's full cross-sectionally correlated and autoregressive model did not converge. The reported R-squared uses Buse's formula, which gives the proportion of explained variance of the transformed dependent variables.

Total Sample

The first two equations in Table 4 (equations 4.1 and 4.2) are estimates of equation (2) based on the two alternative user cost series, excluding any measure of transportation costs. Coefficients on all variables except for the proxies of local expected growth are statistically different from zero with the expected sign. Both changes in growth rates enter with unexpected negative coefficients, and the coefficient on the real income term is statistically different from zero.[4] The negative sign on the change variables can be interpreted, however, as indicating a positive lagged response to the change. Consider the real-income coefficients in equation 4.1. Combining them, the current period response to an increase in real income growth is 0.279 (0.835 − 0.556) and the lagged response is 0.556. Thus, a 1 percentage point increase in real income growth would cause prices to rise 0.279 percentage points faster than otherwise in the period in which the increase occurred and another 0.556 percentage points faster (for a total increase of 0.835 percentage points over the original growth rate) in the subsequent period.

Next, equation 4.3 includes as a regressor a more direct proxy for the change in the deviation of expected inflation in real local house prices from expected national general inflation—the change in the deviation between lagged real growth in local house prices and lagged real appreciation in the national CPI. As was shown above, the ratio (with sign reversed) of the coefficients on this variable and on r measures the relative weight given to expected local house price inflation in the formulation of house price expectations. Unfortunately, this procedure removes observations, because data are unavailable for the years before 1977: one additional observation would be lost for the formulation of the one-year real after-tax interest rate, and five for the seven-year formulation. As a result, this relationship is reported only for the one-year formulation. As can be seen in equation 4.3, the local component is statistically significant, as is r itself. The implied weights on the local-house and national-general inflation components are 0.4 and 0.6, respectively.

Equation 4.4 allows for a direct influence of lagged real local house price appreciation, à la Case and Shiller.[5] Naturally, the statistical fit improves. The 0.39 coefficient is somewhat larger than Case and Shiller's 0.33 average for their four cities. The "long-run" impact (coefficient divided by 1 − 0.39) of changes in real income is substantially increased in this equation vis-à-vis equation 4.3, and the impact of local price appreciation is decreased. Not surprisingly, including the lagged dependent variable eliminates the statistical significance of the change in growth variables which, as argued above, was simply capturing lagged responses. Equation 4.5 drops these insignificant variables.

The final specification introduces an autoregressive error structure

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[4] Examination of the correlation matrix suggests the problem. The correlation of each of the changes in rate-of-change variables with its respective rate-of-change counterpart exceeds 0.5. When variables are highly collinear, they tend to take on coefficients with opposite signs.

[5] Unlike Case and Shiller, this study does not create a separate price index to use as a regressor; see Abraham and Schauman (1991, p. 337) for comments on measurement error and negative serial correlation in repeat-sales indices.

that varies by city, thereby permitting a different lagged response from one area to another. Cities with autoregressive parameters above 0.5 are Cleveland, Detroit, Kansas City, Los Angeles, Nassau-Suffolk, Riverside-San Bernardino, and Santa Rosa. The coefficients in equation 4.6 are similar to those in equation 4.3.

Comparing the estimates with those in the literature, the impact and long-run (impact divided by 0.6) coefficients on construction costs in equation 4.5, which are 0.46 and 0.77, respectively, surround the 0.65 estimate of Peek and Wilcox. In contrast, Poterba's estimate is almost unity. The real income and employment coefficients are all in the 0.3 to 0.6 range, far above the 0.1 Peek-Wilcox estimate (recall that they include the unemployment rate as a regressor), but only a fraction of Poterba's 1.75. Finally, the impact of the real after-tax interest rate coefficient of −0.5 to −0.6 is below Peek and Wilcox's −1.0, but the long-run response in equation 4.5 is −1.0. The similarity between these city results and the Peek-Wilcox national results suggests that this study's coefficients are probably being driven more by the time series characteristics of the data than by the cross-sectional characteristics.

Geographic Subsamples

Table 5 provides estimates with this study's sample divided into two parts based upon geography. One consists of the 14 "similar" Southeast and Upper Midwest cities, and the other contains the more volatile Texas, West, and Northeast cities. The specifications reported are the same as those in equations 4.5 and 4.6.

All coefficients have their expected signs, but the explanatory power is better in the more stable area. Comparing equations 5.3 and 5.1, the R-squared for the Southeast/Upper Midwest area is 0.62, while it is 0.46 for the rest of the country, and the lagged dependent variable is doing more of the work. A comparison of equations 5.4 and 5.2 indicates just how much more of the Southeast/Upper Midwest price variation is explained by the model. Real income growth has a far larger impact in the Southeast/Upper Midwest, while employment growth has a greater impact in the other area. The change in the real after-tax interest rate works roughly similarly in both areas, although a little more strongly in Texas/West/Northeast. Real construction cost inflation has a larger coefficient in the Southeast/Upper Midwest, and changes in lagged local prices work predominantly in the other area.

Time Subsamples

While the data sample begins in 1977, taking first differences and allowing for lags has brought the effective start date to 1979. Thus the first subperiod listed in Tables 1 and 2 cannot be examined. The results

Table 5
Regional Sample Estimates

	Texas, West, and Northeast		Southeast and Upper Midwest	
Equation	5.1	5.2	5.3	5.4
Constant	−.000 (−.0)	.015 (2.0)	−.009 (−3.1)	−.006 (−2.2)
Real Construction Cost Inflation	.325 (1.6)	.229 (1.4)	.433 (3.6)	.564 (5.3)
Employment Growth	.497 (2.9)	.598 (2.8)	.040 (.3)	.100 (1.1)
Real Income Growth	.454 (2.5)	.255 (1.2)	.989 (5.9)	.832 (5.9)
Change in Real After-Tax One-Year Interest Rate	−.424 (−1.5)	−.690 (−2.6)	−.603 (−4.5)	−.527 (−4.9)
Change in Local Price Deviation	−.152 (−2.0)	−.261 (−4.1)	−.000 (−.0)	−.103 (−2.4)
Lagged Dependent Variable	.443 (6.3)		.230 (3.6)	
R^2	.46	.27	.62	.64
Number of Observations	65	65	54	54

from estimating equations with and without the lagged dependent variable for the 1979 to 1982, 1983 to 1987, and 1987 to 1991 subperiods are listed in Table 6. (Note the deletion of 1983, as discussed earlier.) Given the short time series, estimates with different autoregressive parameters for individual cities are not reported.

The explanatory power of the relationship, with or without the lagged dependent variable, is greatest in the most recent period. This may reflect improvement in the quality of the Freddie Mac data over time. All variables have the expected sign, except real income growth in the first period and the change in the local price deviation in the middle period. Real construction cost inflation is significant in all periods, while employment growth is significant in the first and third periods, and real income growth in the middle period. Both the real after-tax interest rate and the local price deviation variables are significant in the first and third periods.

Table 6
Period Sample Estimates

	1979–82		1983–87		1987–91	
Equation	6.1	6.2	6.3	6.4	6.5	6.6
Constant	−.019	−.018	.006	.003	.004	−.014
	(−4.6)	(−4.5)	(.8)	(.6)	(.4)	(−1.6)
Real Construction Cost Inflation	.380	.390	.827	.501	.921	.779
	(2.8)	(3.9)	(6.5)	(4.3)	(3.3)	(3.0)
Employment Growth	.689	.596	.007	.058	1.170	.960
	(7.2)	(3.9)	(.1)	(.5)	(7.5)	(5.5)
Real Income Growth	−.067	−.018	.573	.538	.261	.330
	(−.5)	(−.1)	(3.0)	(3.4)	(1.1)	(1.4)
Change in Real After-Tax One-Year Interest Rate	−1.252	−1.168	−.103	−.256	−1.769	−2.038
	(−4.5)	(−3.9)	(−1.0)	(−2.9)	(−3.7)	(−4.7)
Change in Local Price Deviation	−.201	−.177	−.054	.209	−.437	−.310
	(−3.2)	(−2.6)	(−1.0)	(3.6)	(−5.4)	(−3.8)
Lagged Dependent Variable		.077		.570		.304
		(.8)		(7.6)		(4.0)
R^2	.49	.51	.40	.59	.65	.65
Number of Observations	87	87	116	116	116	116

Explanation of Regional Price Variation

Of obvious interest is the ability of the estimated equations to explain the sharp regional swings in real house price appreciation documented in Table 2. Assuming sufficient ability, of further interest is the source of the variation (real construction cost inflation, real income growth, employment growth, or changes in real after-tax interest rates). This section responds to such interests.

Explanation of Regional Cycles

Table 8 indicates the ability of the equation estimates to explain average real appreciation in four areas in each of three periods since 1979. The areas are California (10 cities), the Southeast and Upper Midwest (14 cities), the Northeast (three cities) and Texas (two cities). But first, Table 7 presents data on employment growth, real income growth, and real construction cost inflation, as well as changes in real house prices, for each of the four areas during each of the three periods. The first period was one of real income decline (except in the Northeast), positive employment growth (except in the Southeast and Upper Midwest), and declining real construction costs. The second period had strong income growth (especially in the Northeast, but little in Texas),

Table 7
Variations in Determinants of Regional Real House Price Changes over Selected Periods
Cumulative log changes

Area Variable	1979–82	1983–87	1987–91
Northeast			
Employment Growth	.025	.114	−.066
Real Income Growth (per Adult)	.027	.161	.007
Real Construction Cost Inflation	−.033	.066	−.037
Change in Real House Prices	.109	.576	−.184
Texas			
Employment Growth	.132	.053	.108
Real Income Growth (per Adult)	−.040	.011	.046
Real Construction Cost Inflation	−.020	−.040	−.095
Change in Real House Prices	−.070	−.215	−.188
California			
Employment Growth	.031	.187	.091
Real Income Growth (per Adult)	−.087	.103	−.005
Real Construction Cost Inflation	−.009	.025	−.074
Change in Real House Prices	−.014	.104	−.280
Southeast and Upper Midwest			
Employment Growth	−.040	.156	.052
Real Income Growth (per Adult)	−.051	.118	.019
Real Construction Cost Inflation	−.041	.025	−.069
Change in Real House Prices	−.134	.096	.032
Change in Real After-Tax Interest Rate	−.013	.019	−.042

employment growth and rising real construction costs (again, especially in the Northeast, but not in Texas). The most recent period has seen negligible real income growth (except in Texas), employment falling in the Northeast but rising in the rest of the country, and declining real construction costs. As shown at the bottom of the table, real after-tax interest rates fell in the first period, rose in the second, and then fell sharply in the third.[6]

Each part of Table 8 begins with actual real appreciation (average cumulative log difference across all cities) and then provides estimates based on the equations with the lagged dependent variable in Table 4 (full sample, equation 4.5); Table 5 (regional sample, equations 5.1 and 5.3); and Table 6 (time sample, equations 6.2, 6.4, and 6.6). While the

[6] When the real after-tax interest rate is recomputed using the Livingston expected inflation rate, the rate rises, not falls, in the first period. However, using this measure does not significantly alter the equation coefficients.

Table 8
Actual and Forecast Growth in Real House Prices
Simple average of total log change, by city, with lagged dependent variables

Area Variable	1979–82	1983–87	1987–91
Northeast (3 cities)			
Actual	.109	.576	−.184
Full sample	.017	.334	−.039
Regional sample	.048	.384	−.051
Time sample	−.018	.400	−.127
Texas (2 cities)			
Actual	−.070	−.215	−.188
Full sample	−.019	−.069	−.103
Regional sample	.014	−.033	−.077
Time sample	.003	−.057	−.033
California (10 cities)			
Actual	−.014	.104	.280
Full sample	−.027	.118	.134
Regional sample	.004	.171	.191
Time sample	−.041	.100	.165
Southeast & Upper Midwest (14 cities)			
Actual	−.134	.096	.032
Full sample	−.112	.116	.028
Regional sample	−.110	.096	−.003
Time sample	−.100	.105	.037

generalized least squares regressions are estimated using transformed variables, Table 8 reports results using estimated coefficients and untransformed variables. Consequently, the forecast growth rates are a little worse than the regression R-squares would suggest.

The full-sample equations explain about one-half of the changes in real house prices over the various periods. The equations do relatively poorly for the Northeast; less than a quarter of the first and third period changes and about 60 percent of the huge 58 percent run-up in the 1983–87 period are explained. Texas is only marginally better; a third to one-half of the real declines in the second and third periods are explained. All of the 10 percent real rise in California in the middle years is explained and half of the rise since 1987. Lastly, the explanatory power for the 14 Southeast and Upper Midwest cities is excellent for all periods.

The regional and time-specific estimates do better in only a few instances. The regional estimates, which for the coastal areas give relatively more weight to employment growth and less to income growth, are better for the Northeast in all periods and in California in the last period. The Southeast and Upper Midwest regional estimate for the final period is worse than for the full sample because it does not recognize the employment gains. The time-specific estimates are better only in the third period and, again, only for the coastal areas. (These estimates also give more weight to employment growth and less to income growth, which improves both fits.)

Table 9 reports the portion of the real house price changes in the regions during the three time periods that can be explained by the preferred regression (equation 4.5), and it indicates which variables account for the explanation. The first number, the actual change, and the second, the static prediction (labeled "fitted change"), are the same as those in Table 8. Also reported is the dynamic prediction, labeled "derived change," in which the lagged dependent variable used is that predicted by the equation, rather than the actual (except in the first year where the lagged value is "known").

The ability to explain either the rapid real price increases in the Northeast during the middle 1980s and in California during the late 1980s, or the declines in Texas since 1983, is sharply reduced when observed lagged real house price inflation is not used (except for the first year of the cycle). Only a trivial amount of these real price movements is explained, except for the extraordinary rise in the Northeast, where 20 points of the 52-point rise are accounted for. On the other hand, the two Southeast/Upper Midwest movements—the decline during the 1980–82 recession and the rebound in the 1983–87 period—are well explained. These areas include one-half of the cities studied. The run-up in California in the middle 1980s is also explained.

The contributions of variables specific to the region are listed below the derived changes in the table. The contributions of changes in the real after-tax interest rate and in the constant, which are the same for all regions, are listed at the bottom of the table. Certainly the most important variables are the rates of growth in employment and real income. These are key to both the real price declines outside the Northeast and the real rise within the Northeast during the 1979–82 period, and also to the real price increases outside Texas in the middle 1980s. Construction costs matter, but only a little. Real construction cost increases contributed to the Northeast's 1983–87 surge in prices (or were caused by it) and real decreases reinforced the continual declines in Texas, but a substantial decline in California's real construction costs during the 1987–91 period did not prevent a sharp increase in real house prices there. Changes in the real after-tax interest rate just as often worked against, rather than supported, the real house price changes observed.

As noted in the discussion of similarities between these results and the national estimates of Peek and Wilcox, this study's equation estimates seem to be driven more by time series variation than by cross-section variation. This can be seen when considering the ability to

Table 9
Decomposition of Forecasts of Changes in Real House Prices

Area / Variable	1979–82	1983–87	1987–91
Northeast			
Actual Change	.109	.516	−.184
Fitted Change	.017	.334	−.039
Derived Change	−.003	.198	−.012
Real Construction Cost Inflation	−.027	.042	−.021
Employment Growth	.010	.053	−.011
Real Income Growth	.022	.128	.021
Local Price Deviation and Lagged Dependent	.005	.023	.004
Texas			
Actual Change	−.070	−.215	−.188
Fitted Change	−.019	−.069	−.103
Derived Change	.002	−.027	−.002
Real Construction Cost Inflation	−.015	−.030	−.057
Employment Growth	.059	.031	.049
Real Income Growth	−.028	.016	.040
Local Price Deviation and Lagged Dependent	.008	.004	−.031
California			
Actual Change	−.014	.104	.280
Fitted Change	−.027	.118	.134
Derived Change	−.059	.130	.015
Real Construction Cost Inflation	−.008	.011	−.045
Employment Growth	.017	.084	.047
Real Income Growth	−.059	.082	.003
Local Price Deviation and Lagged Dependent	.005	.002	.014
Southeast and Upper Midwest			
Actual Change	−.134	.096	.032
Fitted Change	−.112	.116	.028
Derived Change	−.093	.132	.010
Real Construction Cost Inflation	−.024	.011	−.039
Employment Growth	−.009	.070	.028
Real Income Growth	−.039	.095	.020
Local Price Deviation and Lagged Dependent	−.010	.004	.004
Common Variables			
Real After-Tax Interest Rate	.011	−.014	.030
Constant	−.024	−.034	−.034

explain the differences across regions for a given time span. From 1979 to 1982, the largest difference was between the Northeast (+0.11) and the Southeast/Upper Midwest (−0.13). Of this 0.24 difference, only 0.09 is accounted for by differences in the derived changes. For the middle period, this study accounts for only 0.23 of a 0.79 difference (0.07 of 0.48 if Texas is excluded), and for the last period, only 0.02 of a 0.47 difference.

When equation 4.5 is run with time dummy variables, the coefficients on real income and construction cost inflation decline by nearly 50 percent, the coefficient on employment growth rises by about 50 percent, and the coefficient on the lagged dependent variable barely moves, from 0.40 to 0.38. While these coefficient changes are significant, in total they do not increase the ability to explain the large real price swings outside of the Upper Midwest/Southeast group. The alternative coefficients explain roughly 5 points less of the rise in the Northeast in the middle 1980s and 5 points more of the rise in California prices in the late 1980s.

Conclusion

Substantial movements in real house prices have occurred in various regions of the United States during periods of the 1980s. This paper specifies an explanatory framework based on the Capozza-Helsley models. The determinants of real house price changes are seen to be employment and real income growth, changes in real construction costs, and changes in the real after-tax financing cost. Empirically all variables work as expected, with comfortingly high t-ratios. The major driving forces are the growth variables. But the variables are able to explain only about two-fifths of real price changes. The explanatory power rises to above one-half when the lagged appreciation rate is added as an explanatory variable, and to three-fifths with the inclusion of time period dummy variables.

The explanatory power varies widely by region. For half of the cities located in the more stable Upper Midwest and Southeast, the equations explain virtually all of the real decline in the early 1980s and the rebound in the middle 1980s. The equations also pick up the mid 1980s bounce in California, but miss totally the surge in the late 1980s. Increasingly restrictive land use controls may account for much of the seemingly unmotivated increase. In addition, a data problem may also be present. Proposition 13 undoubtedly led many California households to substantially rehabilitate their existing houses, rather than trade up, in order to keep their property tax base down. When these properties finally were traded in the late 1980s, the improvements were reflected in higher prices; in other words, part of the surge in "real prices" was likely an increase in quality.

The inability to explain the sharp price movements in the Northeast and the almost continual real decline in Texas is especially troublesome. Only one-third of the extraordinary run-up in the Northeast in the middle 1980s is explained and virtually none of the subsequent decline. Part of this seems to be a speculative bubble; using the observed, rather than the simulated, lagged appreciation rate explains another quarter of the increase. But that is not nearly enough. It appears likely that the extraordinary stock market rebound beginning in August 1982 had a disproportionately favorable impact on the Northeast because residents of that region hold a disproportionately large share of stock market wealth.

Texas is even more of a problem. The data suggest positive real income and employment growth after 1983. In fact, the growth in Texas after 1987 is the strongest in the country. Possibly, as in the Northeast in the middle 1970s, this seemingly aberrant price behavior is a response to wealth changes, although in this case the change was a negative one associated with the plummeting price of energy.

The explanatory power of the lagged dependent variable confirms the results of others regarding the "inefficiency" of the owner-occupied housing market. Whether these inefficiencies are sufficient for households to make money by "trading" houses seems doubtful, given the tax treatment of this asset and the transactions costs involved. It is doubtful, for example, that many Bostonians shifted to renting in 1987 and 1988 and are now returning to owning.

The authors have both short-run and long-run research agendas. For the near term, the search continues for reasonable employment growth estimates for 1982 and 1983 to eliminate the break in the data at that point, and for some measure of growth restrictions or constraints on city expansion. The authors also plan to test deviations of real house price levels from their trend values, to see if a general tendency exists for real prices to revert to "normal," independent of the model variables. Finally, the hypothesis that recent real stock market capital gains affected the Northeast (and energy price declines affected Texas) more than the rest of the country will also be tested.

In the longer run, the authors' research will be directed toward explaining the full nexus of variables treated here as independent—employment, real income, population, and real construction costs. As Case (1991) and Poterba (1991) have argued, sharp increases in real house prices will stimulate economic activity. Housing starts will increase (the marginal q exceeds 1), and wealthier households will demand more goods and services generally. Greater economic activity will, in turn, attract workers to the metropolitan area. Fully documenting these responses would substantially increase our understanding of regional economic cycles.

Data Appendix

The city house price series are derived using the (geometric) weighted repeat sales technique described in Case and Shiller (1989), as implemented in Abraham and Schauman (1991). Even when creating annual series, the data in some areas are thin enough that it was necessary to smooth a few adjacent years in the early 1980s for three cities. This was done by forcing a constant real appreciation rate (using the local CPI less shelter) over the periods in question: 1977–80 in Boston, and 1980–84 in both Louisville and Minneapolis. This is equivalent to assuming no data are available to permit identifying the timing of inflation during those periods.

A number of technical issues with the Freddie Mac indices, initially raised in Abraham and Schauman, have been given new voice by discussant Bill Apgar. He rightly points out that the measurement of house price changes, as well the explanation of those changes, is fertile ground for intellectual debate.

Apgar questions the magnitude and timing of the local weighted repeat sales indices used in this paper by comparing them to "truth" as revealed by statistical derivations done by Harvard's Joint Center for Housing Studies. Those indices are fitted values or interpolations from hedonic regressions applied to a sample of starter homes identified in the American Housing Survey. Different approaches, especially over small geographic areas and with different population samples, cannot help but be at variance in their behavior.

In addition to the house price indices themselves, the choice of deflators will affect the measurement of real price appreciation. The Joint Center numbers use the national CPIU-X1 to deflate all areas; we use local CPI (less shelter) indices. This can make a difference. For example, in Cleveland the CPI (less shelter) grew 0.5 percent a year faster in the 1980–83 period than the CPIU-X1, and 0.9 percent a year slower between 1983 and 1987. The effect of these differences is to exacerbate the spread between the reported real Joint Center and weighted repeat sales indices.

One issue of concern with the Freddie Mac series is the use of appraisals (from refinancings), rather than arms-length transactions only, for creation of the indices. Since refinancings account for two-thirds of the matched-transactions data set, their use makes possible the creation of many local area indices. Involved statistical work is necessary to test for possible biases in these calculations. Still, cumulative growth rates with and without refinancings for Anaheim, Boston, and Detroit are virtually identical over the period from 1977 to 1991. A slight pattern of differences can be seen over the 15 years: the indices without refinancings grew a little more slowly from 1979 to 1982, more quickly from 1983 to 1987, and more slowly from 1987 to 1991.

The Freddie Mac repeat sale growth rates are adjusted for renovations with a time invariant constant, which implies that dollar expenditures are perfectly procyclically correlated with house values. Apgar's numbers confirm this pattern and match the changes in Table 2 rather well. The finest regional breakout of nominal expenditures on home improvements is the four-Census-region level reported in Census Bureau publication C50. Deflating those numbers with repeat sales price series reduces the dispersion in expenditures across areas. Squinting at the results, one can detect some residual procyclical behavior of "real" improvements, but these deviations from a constant adjustment can reasonably be viewed as a second-order adjustment of a small number (0.5 percent).

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Discussion

*William C. Apgar, Jr.**

Jesse Abraham and Patric Hendershott undertook the formidable challenge of preparing a paper that examines the determinants of price changes in residential real estate over the past several decades. During the 1980s, real estate prices soared in some areas, only to fall back later in the decade. Using metropolitan area price data developed by Freddie Mac, Abraham and Hendershott attempt to address the seemingly simple question, "Was the volatility of the 1980s really a departure from the past?"

Yet the question remains unanswered, largely, I suspect, because of important biases present in the Freddie Mac price measures themselves. This is understandable. Today as much controversy exists about how best to measure historical real estate price trends as about the determinants of these price trends. Nevertheless, "undaunted by statistical fits that are less than spectacular," the authors push ahead in their efforts to develop improved measures of single-family home prices, to use these created estimates of home prices to test a theory of the determinants of the spatial variation in housing prices over time, and to outline a program of future research that will increase the understanding of regional housing and economic cycles.

My comments on the paper, then, are divided into three parts. First, the merits of the Freddie Mac data in examining regional and metropolitan level variation in single-family home price appreciation will be assessed. Brief comments follow on the modeling effort, although my confidence in the results is severely undermined by concern

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about the basic price measures themselves. Finally, some observations will be offered on the research necessary to enhance future knowledge about regional economic housing cycles.

Freddie Mac Repeat Transactions Data Base

The paper analyzes data for 30 metropolitan areas, developed using the Freddie Mac repeat transaction data base. As described more fully by Abraham and Schauman (1991), this data base contains some 8 million single-family home loans that Freddie Mac has purchased and securitized over the past 20 years. Of these transactions, Freddie Mac researchers have identified some 200,000 properties that passed through this process more than once, and they have used information contained in the loan documentation files to develop a transaction-based home price index. Given that for nearly two-thirds of the cases the transaction recorded involves a property refinancing as opposed to an "arm's length" sale to a third party, the Freddie Mac data do not yield a true repeat sales file, but rather a series that blends price trends as measured by market sales and by appraisals.

Since first appearing, the Freddie Mac price indices have generated extensive discussion as to their merits, including published articles by Abraham and Schauman (1991), Peek and Wilcox (1991a) and Haurin, Hendershott, and Kim (1991). Recognizing that Freddie Mac purchases are limited to conforming conventional loans, each paper notes that the Freddie Mac indices may suffer from truncation bias. For example, truncation bias may result from the fact that Freddie Mac data exclude low-valued homes typically covered by Federal Housing Administration insurance, as well as high-valued homes that exceed conforming loan limits. Next, since some share of the data involves appraisals as opposed to sales, the data may be biased to the extent that appraisers systematically overstate or understate market value in particular locations or at a particular point of the housing cycle. Finally, lack of property attributes (including vintage or quality measures) makes it impossible to cleanse the Freddie Mac indices of the possible bias that may result from property improvement or deterioration that may occur between the transactions recorded in the file.

Comparison of the Freddie Mac data with other available price measures suggests the magnitude of these potential problems. In our annual report on *The State of the Nation's Housing*, the Joint Center presents constant quality home price indices for 12 metropolitan areas, derived from hedonic price equations estimated with American Housing Survey data (Joint Center for Housing Studies 1992; DiPasquale, Somerville, and Cawley 1992). Of these 12 metropolitan areas, nine (Boston, Chicago, Cleveland, Detroit, Houston, Los Angeles, Minneapolis, St. Louis, and Washington, D.C.) are also found in the Freddie Mac series.

Simple comparisons of growth rates for four periods (1977–80, 1980–83, 1983–87, and 1987–91) suggest that these two measures of price appreciation differ both in general and in their details. For example, the simple average annual appreciation for these nine metropolitan areas (measured in constant 1989 dollars as deflated by the all-items CPI-UX) derived from Freddie Mac repeat transactions data is some 0.4 percent higher than the Joint Center estimates for the same period. These differences in turn result from the tendency of the Freddie Mac data to fall below the Joint Center estimates early in the period (3.1 percent versus 3.4 percent for 1977–80, and −2.6 percent versus −1.6 percent for 1980–83) and to overshoot later (2.4 percent versus 0.7 percent for 1983–87, and 1.0 percent versus 0.3 percent for 1987–91).

Differences for individual metropolitan areas are also pronounced. For example, Joint Center data for Cleveland suggest that annual home price declines continued well into the mid 1980s (−3.4 percent for 1980–83 and −1.3 percent for 1983–87). In contrast, the Freddie Mac data suggest a sharp reversal over the 1980s (from −5.4 percent for 1980–83 to +0.5 percent in 1983–87).

Recognizing the potential flaws in the Freddie Mac series, several efforts have been made to generate an adjusted series. While these efforts may yield appropriate adjustments for a national level price index, I am less than optimistic about the success of these adjustments for individual metropolitan series. To illustrate this concern, consider the Peek and Wilcox (1991a) proposal to adjust the data for omission of the effect on dwelling unit quality of unreported expenditures for repair, maintenance, and improvement. Drawing on Census Bureau data on these types of homeowner expenditures, Peek and Wilcox estimate a national average net residential investment measure. Using these data, they estimate that adjusting for the omitted quality effect alone could reduce the overall national real home price appreciation, as measured by the Freddie Mac series, from 31 percent to 14 percent for the period from 1970 to 1989.

Abraham and Hendershott recognize this problem and, indeed, following the lead of Peek and Wilcox, adjust their metropolitan repeat-sales indices by 1 percentage point annually to account for possible upward biases from sample selection and home improvements. While this adjustment may work to correct the national index, it seems unlikely that a single national average adjustment is the correct adjustment in all metropolitan areas. In particular, the extent to which homeowners invest in their homes varies over time and location. Moreover, there is reason to believe that part of this variation itself is related to the same demand factors that stimulated rapid price appreciation in selected regions.

Consider, for example, the "rehab boom" that occurred in the mid 1980s. Measured in 1989 dollars, from 1984 to 1989 the per unit expenditure on residential upkeep and improvement grew by more than 60 percent in the Northeast and West, while real per unit expenditures declined slightly in the Midwest and South (U.S. Bureau of the Census 1991). As a result, by 1989 per unit expenditures ranged from highs of $1,501 and $1,399 in the Northeast and West to the lower figures of $1,078 and $880 recorded in the Midwest and South. While these figures undoubtedly mask even greater variation at the individual metropolitan area level, the conclusion seems clear: a simple adjustment may be sufficient to correct national data, but it seems unlikely that such a simple fix will go far in adjusting local data for the effects of unobserved home improvements.

In addition to the need to develop regionally specific adjustment factors, users of the Freddie Mac data would also be wise to consider the effect of the various types of truncation biases present in the sample. While the two types of truncation may offset one another at the national level, it seems likely that the relative importance of each type of truncation will differ from one area to the next. In particular, in low-cost areas, Federal Housing Administration programs may account for a larger share of sales, and hence truncation at the low end of the distribution may be relatively more important. In high-cost regions, in contrast, concerns about changes in the upper limit may be more pronounced.

This review does not offer any suggestions as to possible types of metropolitan area corrections, in large measure because the Abraham and Hendershott paper presents no information on the sample size or other aspects of the specific Standard Metropolitan Statistical Area (SMSA) estimates required to complete such a detailed assessment. While recognizing the need for further review, I emerge from this exercise with serious reservations as to the use of the Freddie Mac series to measure house price trends at the metropolitan area level. Oddly enough, I now share the conclusion reached by Hendershott when he wrote just last year with Haurin and Kim (1991) that "Both our regional and annual calculations cast doubt on the rapid appreciation of house prices recorded in the Freddie Mac repeat-sales index in recent years." This is unfortunate, since local area price measures are exactly what is needed. While further research on possible correction methods may serve to offset some of the concerns raised here, for now I have much more confidence in the validity of the Freddie Mac measures when applied to national, as opposed to metropolitan area, price analysis.

Modeling and Estimation Issues

In this paper, Abraham and Hendershott assume that spatial variations in construction costs fully capture changes in structure value and thus "the only task is to explain land values." While this formulation ignores the possibility that structure prices may diverge significantly and for some extended period above or below the replacement cost of similar structures, there can be little doubt that variations in land prices are a major component in both cross-sectional and time series variation in home prices.

In their effort to explain home prices, Abraham and Hendershott draw on a model initially presented by Capozza and Helsley. Under the formulation presented here, in addition to real construction cost inflation, metropolitan variation in home price appreciation is a function of local employment growth, local real income growth, changes in the real after-tax financing cost, and area-specific measures of expected appreciation in real house prices.

Despite the obvious data problems, Abraham and Hendershott do manage to produce plausible equations for the entire sample of observations. Yet they take little comfort from their initial equations when they also report decidedly less satisfactory results for subsamples based on time and broad regions of the country. Unfortunately, the authors provide little interpretation of the observed differences in the coefficients generated from the geographic and time samples.

Absent more careful assessment of why the coefficients ought to vary over time or location, I have little confidence in the findings as presented. My doubts are enhanced, of course, by my conjecture that measurement errors may differ by time period and region. For example, consider the concern about the potential upward bias in the price indices for the mid 1980s. Abraham and Hendershott argue here that increased sample size actually has improved the quality of the metropolitan area estimates for the mid to late 1980s. Thus they observe that the improved performance of the model at the end of the period could, in fact, reflect this improvement in the quality of the price information. Alternatively, of course, improved model fit for the 1983–87 and 1987–91 segments could also simply reflect the fact that a misspecified model was fortuitously rescued by a spurious correlation induced by non-random measurement error in the estimates of metropolitan area price changes.

Concern about model performance is further heightened by even a quick review of what is omitted from the model. Most obvious is the failure of Abraham and Hendershott to incorporate demographic factors into their model. Since the release of the Mankiw and Weil paper (1989) on the influence of the population's age structure on housing prices, numerous papers have examined the linkage between demographics and housing price dynamics. While the Mankiw and Weil formulation has been widely discredited, other studies have discovered significant linkage between various measures of the age structure of the population and home price appreciation (for example, Peek and Wilcox 1991b; Case and Shiller 1990). In any event, the omission of demographic factors here is striking.

Equally striking is the omission of any discussion of the ways that growth controls, zoning, or other land use restrictions may have contributed to the increase in land prices and in turn single-family home prices. Recently, home builder groups have stressed the potential adverse effects on home prices of the growing use of exactions to finance urban infrastructure development. Indeed, support appears to be increasing for the observation that exactions do in fact raise home prices.[1] In any event, I remain less than convinced that the simple formulation presented by Abraham and Hendershott adequately captures the regional and temporal variations in the effect of changing land use regulations on housing cost. At minimum, this issue deserves some comment in their paper.

Future Research

Given my generally critical comments about the Freddie Mac data and the specific modeling exercise, I close with some comments on future research. First, I applaud the spirit with which Abraham and Hendershott present their findings. The lack of residential housing and land price indices represents a major impediment to developing an improved understanding of regional economic and housing cycles. Abraham and Hendershott approach the task given them with energy and skill. One can only praise Abraham and Hendershott and other researchers at Freddie Mac for developing an admittedly problematic but nevertheless valuable new source of housing price data. It is to be hoped that other major institutions involved in housing will join in Freddie Mac's effort to develop improved measures of housing and land prices.

Admittedly, much remains to be done. I firmly believe that the required data will be difficult to develop, and that new prices indices like Case and Shiller's will be created, city by city, where historical home sales data can be retrieved and examined. Promising in this regard is the effort now underway at the Department of Housing and Urban Development (HUD) to attach sale price data to observations included in the American Housing Survey. Such an effort will undoubtedly increase

[1] See, for example, the review of the exaction literature by the Kennedy School's Alan Altshuler and Tony Gomez-Ibanez (1993).

knowledge of home price trends, and could eventually lead to creation of Census-based home price indices for individual regions.

Yet as Abraham and Hendershott remind us, improved measures of home prices are but part of the required work. In addition, much work needs to be done to better understand other elements, including local determinants of employment, income, construction costs, land prices, and new and existing housing starts. House prices are important determinants of household wealth, and thus themselves may stimulate consumer expenditures. Ongoing Joint Center research suggests that household wealth is an important determinant in the household's decision to undertake expenditures for residential maintenance, repair, and improvement; but as Case has argued, real wealth accumulation undoubtedly influences other expenditure as well.

Additional work is also needed to examine what appears to be the changing pattern of regional and metropolitan area construction cycles. In particular, preliminary work by the Joint Center's Jim Brown and Chris Herbert, reported in *The State of the Nation's Housing, 1992*, points to the growing influence of local market conditions as determinants of regional building cycles. Nationwide, during the 1970s, the number of housing units built reached a cyclical low in 1974–75, rose to a peak in 1977–78, and then fell sharply to another trough in 1981–82. Residential construction in most states followed this national pattern, with 43 states reporting a low in 1974–75, the same number hitting a high in 1977–78, and 48 falling to another low in 1981–82. The pattern of regional cycles in the 1980s stands in sharp contrast. Unlike the 1970s, construction levels in only 22 states peaked with the national total in 1985–87. Instead, housing production in 18 states moved up quickly after the national recession, peaked in 1983–84, and then declined. In the remaining 10 states, housing construction continued to increase until 1988 or later.

These trends suggest, at a minimum, the need for careful assessment of the interplay between national economic factors and local factors as they influence regional building cycles. They suggest further that the 1980s may differ in fundamental ways from previous periods, confounding the ability of researchers to use time series data to explore metropolitan area-specific relationships. Finally, they are further reminders of how difficult was the task handed to Abraham and Hendershott, in their charge to explain patterns in residential real estate prices.

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Discussion

*James A. Wilcox**

It has long been thought that commercial real estate lending posed a number of risks. That perception has proved correct. Many of the risks associated with holding securities with fixed interest rates, such as fixed-rate mortgages secured by residential real estate, have long been recognized as well. But at least until recently, the credit risks associated with single-family real estate lending were judged to be fairly low and manageable. It may be, however, that recent actual and prospective mortgage default rates, and the magnitudes of the losses per default, now suggest a somewhat different picture. Published reports pointing to trouble in the portfolio of one of the nation's largest originators and holders of single-family real estate mortgages may confirm that revised perception.

A recovery of the macroeconomy may have been under way for some time now, but if so, it has been slow and uneven. In this instance, California has been in the unaccustomed role of follower, not leader. Seemingly immune to serious economic difficulties at the end of the 1980s, California saw its unemployment rate move to nearly 10 percent in the summer of 1992. As California labor markets have softened, the specter has been raised of substantial declines in house prices, generating large numbers of residential and commercial real estate defaults. In light of experience in Texas and New England, concern has grown about banks that have dedicated considerable portions of their portfolios to mortgages collateralized by California real estate, and about the impact those banks' difficulties could have on those who typically rely on them for credit.

Jesse Abraham and Patric Hendershott advance our understanding of residential real estate markets, both local and national, first by

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providing us with superior quality data on house prices. They use the Freddie Mac data base to construct time series of annual nominal house prices for 30 cities. One of the primary virtues of this series is that it controls for the effects on house prices of location, one of the three things that realtors contend determine house prices (the other two being location and location). Until the advent of the regional and national house price indexes based on the Freddie Mac data, which were pioneered by Jesse Abraham, studies relied heavily and unavoidably on a number of seriously flawed house price series. Though not perfect, the repeat sales house price indexes based on Freddie Mac data are arguably the best available (Peek and Wilcox 1991).

The citywide house prices that Abraham and Hendershott have constructed have some notable and useful features. First, nominal house prices declined relatively infrequently over the non-overlapping three- or four-year periods shown. These years are not exactly peak-to-trough subperiods, but they are close. In that regard, though the periods should not be strictly interpreted as showing the historical "worst-case scenarios," Abraham and Hendershott's Table 1 may accurately indicate the extent to which nominal house prices exhibit downward stickiness. Or, it may also reflect the circumstance that substantial real declines were warranted during a period of considerable general inflation, which obviated the need for nominal declines. Fortunately, neither after-tax real interest rates nor unemployment rates are likely to increase enough in the near term to warrant real declines in house prices as large as those recorded in the early 1980s.

Second, the data confirm the widespread impression that inter-regional house price movements are not highly correlated over short periods. In Table 1, it is easy to find examples of annualized rates of regional house price appreciation differing by more than 10 percent for periods of three or four years.

Perhaps more interesting is the fact that the data indicate considerable divergences of (at least short-term) price movements within regions. In the most recent subperiod shown, for example, annualized appreciation rates within the Southeast region spanned a range of more than 6 percentage points. This suggests that a portfolio consisting of mortgages originated within a fairly circumscribed geographic area may still exhibit a considerable amount of economic diversification.

The authors derive estimates of the effects of various determinants of house prices, rounding up the usual suspects (income, population, interest rates, and so on). At various places in the paper, they seem disheartened by the difficulty of finding a stable, tight explanation for their house price data.

First, it is worth remembering what a daunting task Abraham and Hendershott have set for themselves. Their goal is to explain short-run changes in the prices of long-term assets that are anchored in dozens of different cities. These prices ought to, and apparently do, respond to both national and local factors. Furthermore, they are likely to respond to both actual and expected conditions. The sample period covered by the data, which are available from 1977 through 1991, comprises one of the most macro- and microeconomically turbulent periods in memory. Over that 15-year period, major shocks generated some temporary and some permanent reverberations in tax policy (including income tax rates), land use regulations, monetary policy, fiscal policy, international trade patterns, energy markets, labor markets, and other areas germane to house prices. These cities are geographically small areas subject to all kinds of idiosyncratic shocks, in addition to macroeconomic forces. The cities themselves differ in size, diversification, and physical limitations to expansion.

The events of this period, and the wide variance in the severity of their repercussions across cities and regions, could reasonably spur us to consider whether an entity so large and disparate as the United States is best served by having but one central bank. Certainly our experience ought to convey some information to those who are considering an amalgamation of varied Western European economies under the banner of a single monetary authority. Indeed, the house price data produced by the authors may be one of the best available indicators of the dispersion of outcomes across regions subject to some of the same fundamental public policies.

Second, one can take some comfort from the verification of several aspects of conventional wisdom. Like Poterba (1991), Peek and Wilcox (1991), and others, Abraham and Hendershott document the statistical correlation between house prices and construction costs and household incomes. I find it encouraging, though the authors do not mention it, that the estimated coefficient on land value in their five-year-average data sample is in the neighborhood of the share of land in total cost. It is less encouraging, and the authors do mention this, that the coefficient on construction costs vastly exceeds their share of total costs.

Abraham and Hendershott note that all is not well in their estimates of annual real house price appreciation. Though results of formal stability tests are not presented, they indicate that their estimated equations are unstable both across time and across space. As Hendershott (1991) has pointed out, such instabilities should caution us that some important aspects of the determinants of house prices may be missing from the current specification.

One notable, if not altogether explicable, finding is the significant and fairly robust effect of the adjustable rate mortgage (ARM) interest rate on house prices. It is not clear that the ARM rate is more relevant than the rate on fixed-rate mortgages (FRM), based on the results shown in the authors' Table 4. It would be worth knowing which prevails in head-to-head competition. Of course, both may be relevant. One signal that the ARM interest rate may be proxying for the FRM rate is that, in their Table 6, the estimates show that the ARM measure was relevant even in the 1980–82 subsample, a period when ARMs were still virtually nonexistent.

The authors' estimate of the response of house prices to incomes strikes me as being implausibly high. Suppose that over the longer run, real incomes per adult (due to productivity advance) and employment (due to population growth) each were to grow at 1.5 percent annually. Table 4 implies that real house prices would rise by a similar amount. (The implied increase may be either larger or smaller, depending on which column is used and what interpretation is given to the explicit or implicit lagged dependent variable coefficient. An elasticity of 1.0 for the sum of the employment and income effects was used as an illustrative matter.) One implication of a price elasticity of this magnitude would be that (constant-quality) house prices rise as fast as per capita incomes. If the long-run, real supply price of structures is constant, then the price of land would rise by 1.5 percent times the inverse of the share of land in house prices. Taking land's share of total costs to be about one-third, real land prices would rise by an average of 4.5 percent per year. This is far in excess of what we have observed over the long run.

Another piece of good news, however, is that many of the awkward aspects of these results may be related to a single phenomenon. The problems of instability and of somewhat surprising coefficient patterns may in effect reflect the omission of some relevant variable(s). Here, I focus on one candidate for inclusion in particular: the deviation of the actual from the "steady-state" *level* of real house prices.

The problem with the authors' specification, which uses growth rates only, is that no avenue is provided for real house price levels to revert to their equilibrium or steady-state levels. (It also commonly generates significant constant terms that are difficult to interpret: Are real house prices expected to change continually for unspecified reasons?) In currently fashionable jargon, the specifications used here lack an error-correction mechanism, which provides the channel for the reversion of real house prices to the levels implied by the long-run, possibly co-integrating, relation between house prices, incomes, construction costs, and interest rates. The specification in terms of levels presented in Peek and Wilcox (1991) might be taken as an example of such a steady-state relation. The latter specification, however, may be conversely misspecified: it does not incorporate dynamics.

Allowing an error-correction mechanism might contribute to the explanation for the convergence phenomenon the authors point to when they note that some of the cities that had the largest price increases during the 1980s have more recently seen nominal price declines. To the extent that cities with the greatest price appreciation are also likely to be those whose prices came to most exceed their steady-state levels, a tendency to revert to those levels may well have contributed substantially to the ensuing price weakness. In that regard, house prices may exhibit characteristics similar to the "winners become losers" phenomenon some have claimed for the prices of individual stocks.

Like Case and Shiller (1989), Abraham and Hendershott report a significant effect of lagged appreciation on current house price appreciation. That may be consistent with inefficient pricing of houses, but the ability to forecast excess returns on housing would be more convincing. Indeed, Case and Shiller indicate that excess returns are even more forecastable than are returns. Thus, this paper's evidence adds to the accumulating stock of indications of the inefficiency of house prices.

Abraham and Hendershott doubt, however, that the extent of price inefficiency is sufficient to provide excess-profit opportunities for households to exploit. The transactions costs in this market may, as they suggest, preclude taking advantage of such opportunities to the fullest; if they did not, we would likely see no evidence of inefficiencies remaining in the data. But it does seem that households have often tried to exploit these opportunities on the up side, either by buying additional houses or by living in larger houses than would otherwise be purchased at that stage of the life cycle. To the extent that they expect that houses would produce negative excess returns, households likewise seem to defer or reduce house purchases.

The data constructed by Abraham and Hendershott illustrate how differently house prices, real or nominal, may behave for extended periods in different areas. Although most observers will not find this surprising, with these data it is possible to readily calculate a fairly high-quality estimate of the extent of covariation. Armed with such estimates, investors can more accurately select the degree of portfolio diversification they prefer. As an aid to such selection, it would be worthwhile to group cities according to the similarity of their house price function estimates.

Cities, as opposed to nations, may be the relevant areas over which to examine whether price inefficiencies in the form of speculative bubbles have emerged. National indexes obscure divergences of local house prices both from national trends and from the fundamentals relevant to a given locality. Thus, the availability of local house price indexes permits investigation of whether past house prices help forecast future excess returns on houses but also whether, for example, significant "spillovers" occur: do developments in one locality help forecast excess returns in (economically or geographically) neighboring markets?

Abraham and Hendershott suggest that the value of economic modeling of house prices is reduced to the extent that house prices are set inefficiently. In that case, a combination of typically considered economic forces and variables designed to measure "speculative" factors may still track and even help forecast house prices. It may even be that such models become more valuable to the extent that houses are priced inefficiently. When house prices exhibit "overshooting and reversal," it may be that economic modeling will be able to forecast the (excess) returns on houses to some extent. Such models may not always be able to explain house price movements very precisely, but such models may well track or even forecast the overshooting and reversals. And even absent those abilities, they may indicate when house prices are "bubbling." In that regard, a model that is unable to account for the high level of house prices might indicate that houses are "overpriced." A model that can emit those kinds of signals could prove extremely valuable.

Housing market participants may well forecast house price changes, as this paper's results indicate they usefully could, at least partially on past house price changes; those changes exhibit quite strong positive autocorrelation. Such patterns of prices and forecasts may provide some hint about current mysteries. Given sluggish and even declining prices in some areas in recent years, both buyer demand for and lender supply of mortgage credit may have been reduced by the implicit forecasts of negative excess returns. That perspective, perhaps if likewise applied to the commercial real estate market, might provide an alternative to the "credit crunch" as a primary source of the reduced flows of credit to these sectors.

In that case, it may be that no appeal to bank capital developments, or any other source of credit crunch, would be required to observe credit growth that is slower than in earlier periods and slower than predicted by models that omitted such (perhaps irrational) forecasts. Rather than investing in houses or in any other asset whose excess returns appear to be persistent in general, and negative at present, both potential mortgage borrowers and lenders might prefer to move to instruments whose excess returns exhibit little persistence, such as Treasury issues, and instruments whose returns are explicitly or implicitly linked to them, such as money market and bond funds. While that may help explain some of the increased portfolio shares of those instruments in the early 1990s, it would, on the other hand, seem to intensify the puzzlingly slow growth of the demand for M2.

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