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PATTERNS AND DETERMINANTS OF METROPOLITAN HOUSE PRICES, 1977-91

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ABSTRACT

Real metropolitan house prices have been quite volatile during the 1977-91 period, with half of our 30 areas having annual increases of above 15 percent in a single year and a third having decreases greater than 7.5 percent. Drawing on Capozza and Helsley's models of real land prices, we express real house price changes as a function of the rate of change in employment, real income growth, real construction cost inflation, and changes in real after-tax interest rates.

Our explanatory power varies widely by region. We do quite well for the half of our cities in the more stable Upper Midwest and Southeast, less well for the coastal cities, and dismally for the two Texas cities.

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Jesse M. Abraham and Patric H. Hendershott

Local real house prices have exhibited substantial volatility in the United States in recent years. Real prices in virtually all of the widely dispersed selection of 30 cities analyzed in this paper have increased by over 10 percent and decreased by more than 5 percent in individual years during the 1977-91 period. In fact, half had real increases above 15 percent and a third real decreases greater than 7.5 percent.

Swings in regional house prices clearly mimick regional economic cycles. Between 1977 and 1980, the average real appreciation in eleven 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 half of our ten California cities 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 in real price changes are systematically related to economic cycles. To date, empirical studies have not resolved this question [Abraham (1989), Capozza and Schwann (1989), Case and Shiller (1990), and Poterba (1991)]. These papers have focussed on other issues, and, we speculate, the authors have been discouraged by their generally poor statistical fits.

A common theme in popular explanations of real house price changes is overshooting and reversal. For example, a thoughtful recent 'event study' of the Boston experience by Case (1991) concludes that the local cycle in real estate values drove the employment cycle to extreme heights and now depths. Seattle's sharp reversal in 1981-83, the Northeast's decline since 1988, and California's current reversal seem consistent with this theme. Combined with an earlier Case-Shiller paper (1988), one is left with the impression that 'speculation' -- a force 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.

We proceed to analyze and attempt to explain metropolitan area real house price movements during the 1980s, undaunted by less-than-spectacular statistical fits. Our source for metropolitan price data is the Freddie Mac repeat-sale data base (Abraham and Schauman, 1991). The appendix discusses the construction of our price series.

We begin in Section I with the simple identity that house value is the sum of structure and land values and illustrate that construction costs and land values can, in fact, explain a significant amount of the variation in real house prices over five year periods. Our extended framework, which draws heavily on Capozza and Helsley's (1989, 1990) modelling of real land prices, is described in Section II. The primary determinants of real house price appreciation 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.

In Section III, we test the model with data from 29 cities over the 1979-91 period. 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 we would like. Nonetheless, we illustrate in Section IV that the model can explain a significant portion of the variation described above, at least for the half of our cities in the Upper Midwest and the Southeast. The major driving forces have been employment and real income (per adult) growth. A concluding section draws together our findings and provides some suggestions for future research.

I. PRELIMINARY FINDINGS

Data are analyzed for 30 metropolitan areas using data drawn from the Freddie Mac repeat transaction database. These are the maximum number of areas with sufficient house sales to compute indexes for the 1977-91 period (and even here there are a few adjacent years in the early 1980s that need to be "smoothed"). In this brief introduction to the paper, we both illustrate the area data and report some preliminary five-year regressions.

The Data

Table 1 contains growth rates in nominal house prices for the MSAs for the 1977-80, 1980-83, 1983-87, and 1987-91 periods (the data are averages during the year; thus the 1977-80 period, for example, should be interpreted as the growth from the middle of 1977 to the middle of 1980). The 30 areas in the table have been subdivided into the West (ten California areas plus Seattle), the Midwest (eleven), and the East (eight). These three areas are further subdivided into their northern and southern parts. At the bottom 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 the East cost shows modest dispersion, with the northern areas being stronger in the early 1980s and the southern areas stronger later in the decade. In contrast, the Midwest exhibits much diversity. House prices appreciated at nearly a five percentage point greater annual rate in the two Texas cities in the 1977-83 period than in the Upper Midwest and over a five percentage point slower annual rate in the 1983-91 period. Moreover, the annual appreciation rates in Dallas and Houston differed from each other by about 5 percentage points in three of the four periods, and individual cities within the Upper Midwest had appreciation rates that differed by over 6 percentage points from each other 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 different 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 in the most recent 1987-91 period. The rates for the two areas may be converging, however. In the most recent 1990-91 period, the four MSAs with the greatest nominal deflation were Boston, Nassau-Suffolk, San Francisco and San Jose, ranging from -7.6% to -4.0%.

The cities in the Midwest and Southeast regions had overall appreciation rates that ranged from 4.4 to 7.9%, with the exception of Houston, which appreciated at only a 2.4 percent rate. 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% between 1983 and 1988. Dallas, which had enormous appreciation in the 1977-80 period, suffered a 20% cumulative nominal price decline between 1986 and 1990. More northernly areas also did poorly. The two Lake Erie cities, Cleveland and Detroit, experienced no nominal increases between 1979 and 1984, a period when the consumer price index rose by a third.

Table 2 lists the same data except that the appreciation rates are in real terms using local CPIs net of shelter as deflators. Also, for the Midwest cities only, we have partitioned the first two periods at 1979, not 1980, reflecting their real house appreciation turning negative a year earlier than that 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% per year in real terms, and the Northeast did remarkably well in the middle two periods, experiencing 5% real growth in the 1980-83 period, when the rest of the country was undergoing real price declines, and a remarkable 15% in the 1983-87 period. Real prices fell by 5% in the Texas cities during the last two periods (with especially large declines in Houston in the first of these and in Dallas in the second), but rose by 9% in 1977-79. The Upper Midwest has strong 6% real appreciation in the late 1970s, but real prices fell by almost 5% annually throughout the 1979-83 period.

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 is typically 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, we would think that a construction cost index and an accurate land value index would largely explain house prices.

Poterba (1991) tested the importance of land values to house prices by regressing five-year changes in real median (NAR) house prices on five-year changes in estimates of real "improved, 10,000 square-foot lot" values for 29 city observations from 1980-85 and 1985-90 (Black, 1990). The estimated coefficient on land value was 0.29, and the R-squared was 0.27. He concluded that, while statistically significant, land prices don't tell much of the story about metropolitan variation in house prices. Of course, the "improved" lot values are land on the peripheries of the metro areas and thus likely would not adequately reflect how land under the "prime close in" suburban houses is valued. That is, land "not mattering enough" in this equation doesn't necessarily mean that land, appropriately measured, doesn't matter enough.

We have 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). There are two possible data differences. First, we find 33, not 29, city observations where both NAR median house price and ULI land price data are available. Second, we have deflated by local CPIs less shelter; Poterba does not discuss his deflators.

We report similar equations using changes in real construction costs, as well as real land values, as regressors to explain real appreciation in our repeat-sale, rather than the NAR median, house price series. In order to use as large a data set as possible, we attempted to compute five-year appreciation rates for all the metropolitan areas in which Black reports land values, even if we cannot obtain "reasonable" data for the full 1977-91 period. While our basic annual 1977-91 data set includes only 13 of his 30 areas, we were able to compute reasonable data for 16 areas for 1980-85 and 19 areas for 1985-90, giving us 35 observations.

For a general construction cost measure, we use the National Income and Product Accounts residential deflator, which is really the Census Bureau deflator for new houses excluding the value of the lot, not an index for both multifamily and single family construction. To obtain city-specific cost estimates, we multiply the general index 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 matters. The real residential deflator fell by 6 percent in the 1980-85 period and was constant in the 1985-90 span. In contrast, the real Means index fell by 6 percent in the latter period and was flat in the former.

These results are also reported in Table 3. In these regressions, the repeat-sales indices are reduced by one percentage point annually to account for possible upward biases from sample selection and home improvements [see Abraham (1990), Abraham and Schauman (1991) and Peek and Wilcox (1991a) for discussions of these issues]. The growth in construction costs was also reduced by a percentage point annually, permitting the replacement cost measure to reflect depreciation in the structure. (These adjustments affect the constant term only.)

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 growth rate in real construction costs is added, 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. Especially in light of our concerns regarding the likely location of the land at the periphery of the metro area, we conclude that construction and land costs explain a large proportion of house price changes.

The last two equations in Table 3 are run on the 17 data points common to both our data set and the NAR's. With Freddie Mac data, coefficients (except for the constant) similar to those in equation (3.3) are obtained, and the R-squared is 0.52. With NAR data, 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.

II. MODELING METROPOLITAN HOUSE PRICES

Assuming that movement in structure value can be captured with movements in a construction cost index, the challenge is to explain land values. As a framework for doing this, we turn to the urban economics literature, more 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 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 the larger is the city, introducing the number of households (H) and real transportation costs per unit distance (T) as determinants of metro land values. Lastly, the "growth premium" owing to expected future rent increases depends on expectations of future household growth. We summarize their equation (24), which expresses the average value of developed land in a city, as

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

where h is the expected household growth rate.

Because Capozza and Helsley assume that the consumption of land per household is fixed, real income does not appear in (1). Allowing land consumption 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 land consumption 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 land gradient 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 fixed, all real income changes are translated into real rent changes via the budget constraint. A relationship like (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 it (and the irreversibility of development) slows development and thus raises 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 (e.g., cities bounded by water or mountains).

We draw on both of these frameworks and include the (replacement cost) value of the structure because we are explaining house, not land, prices. For the household and real income per household variables, we use employment and real income per working age (25 to 64) adult, E and Y, and we denote construction costs with C. Our estimation equation in percentage rate-of-change form is:

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

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

Earlier Studies

We now briefly compare equation (2) 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 level of newly-constructed house prices was significantly positively related to the number of households, an estimate of expected housing completions, and the nominal interest rate. The level was significantly negatively related to the real pretax interest rate and a time trend. Because newly-constructed houses are generally on periphery land, we would not expect the urban land model 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 1980-89 period. Of our model variables, he used construction costs (see earlier discussion) 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) find 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 a large influence of an age-composition variable 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 (1992) has shown that the Mankiw-Weil relationship did not hold in the 1970s and 1980s, i.e., in the period Poterba studied.[1] Peek and Wilcox found a significant negative relationship between real house prices and the ratio of population aged 20-29 and population aged 30-54.[2] Demographic influences beyond our employment and real income variables are not supported by the theoretical model.

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 lagged one year real appreciation, the coefficient being about a 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 discussed above. The local CPIs net of shelter are from Data Resources Inc. Employment data and population aged 25-64 are from Regional Financial Associates. Because no employment data are available for Seattle prior to 1985, this city has been deleted from our sample. Income data are from the Bureau of Economic Analysis, Department of Commerce. Because the 1991 MSA income and population estimates are not yet available, we have used the WEFA Group forecasts to estimate these numbers. The general deflator is the CPIU-X1, which is the national consumer price index purged of the mismeasurement caused by rapid increases in mortgage rates in the late 1970s and early 1980s [see the Bureau of the Census (1991)].

We test two formulations of the real after-tax interest rate (RAT). The first takes a longer term (or fixed-rate mortgage financing) approach. We use the seven-year Treasury 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 last 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 takes a short-term (or ARM) approach. We use the one-year Treasury rate for the financing rate and last year's national CPI appreciation rate for expected inflation.

Deviations of local house price expected appreciation from national general expected appreciation are presumably captured by unexpected changes in the employment and real income growth variables. We proxy the unexpected changes by observed changes. Alternatively, we could attempt to proxy these deviations directly as functions of past general and local appreciation.

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 is the weight given to the national rate. This expression can be rewritten as

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

If we included the bracketed first term (the RAT interest rate using the expected national inflation rate) and (pn-pl) as regressors and obtained estimated coefficients of a and b, respectively, we would compute 1-w as b/a.

II. METROPOLITAN RESULTS

We report our results in three parts. First, we provide estimates for the full 29 city sample. Then we discuss results for a geographical partitioning of the data: the Northeast, Texas and West (15 cities) versus the Southeast and Upper Midwest (14 cities). Finally, we report results for the 1980-82, 1983-87, and 1987-91 cycles. Note that 1983 has been deleted from the sample because the metropolitan areas were expanded in that year, creating a spike in employment growth in that year. The purpose of the subsample estimates is to determine whether the results are robust across space and time.

Before getting into the actual estimates we have a few words on the estimation method. 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 (see White, 1990). Heteroskedasticity is permitted across cities by a two-step procedure that estimates an OLS regression, transforms each variable by the estimated standard error, and then runs a second OLS regression. This was done 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 therefore assumed to be block diagonal. Estimation of Kmenta's full cross-sectionally correlated and timewise 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 are estimates of equation (2) based on the two alternative user cost series, excluding a measure of transportation costs. Coefficients on all variables except for the local expected growth proxies 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.[3] There is, however, another interpretation of these variables. The negative sign on the change variable suggests a positive lagged response. Consider the real-income coefficients in equation 4.1. Combining them, the current response is 0.279 (0.835-0.556), and the lagged response is 0.556.

Next we include as a regressor a more direct proxy for the change in the deviation of expected real local house price inflation from national general expected inflation -- the change in the deviation between lagged real local house price growth and lagged real national CPI appreciation. 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 from our data set because we do not have data before 1977: one additional observation would be lost for the one-year RAT formulation and five for the seven-year formulation. As a result, we only report this relationship 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 components are 0.4 and 0.6, respectively.

The next equation allows for a direct influence of lagged real local house price appreciation a la Case and Shiller.[4] Naturally, the statistical fit improves. The 0.39 coefficient in equation 4.4 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-a-vis 4.3 and the impact of local price appreciation is decreased. Not surprisingly, entering the lagged dependent variable directly eliminates the statistical significance of the change in growth variables, which we argued above were really just capturing lagged responses. Equation 4.5 drops these insignificant variables.

The final specification introduces an autoregressive error structure that varies by city, thereby permitting a different lagged response from one area to another. Cities with auto-regressive 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 4.3.

Comparing these estimates with those in the literature, the impact and long-run (impact divided by 0.6) coefficients on construction costs, 0.46 and 0.77, surround the 0.65 estimate of Peek and Wilcox. In contrast, Poterba's estimate is almost unity. Our 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 RAT interest rate coefficient of -0.5 to -0.6 is below Peek and Wilcox's -1.0, but the long-run response in 4.5 is -1.0. The similarity between our city results and the Peek-Wilcox national results suggests that our 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 our sample divided into two parts based upon geography. The first consists of the 14 "similar" Southeast and Upper Midwest cities, and the second contains the more volatile Texas, West and Northeast cities. We denote the second group by "other." 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 quite a bit better in the more stable area. Comparing equations 5.1 and 5.3, 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 5.2 and 5.4 indicates just how much more of the Southeast/Upper Midwest price variation is being explained by the model. Most significantly, 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 RAT works roughly similarly in both areas, although a little more strongly in the West/Northeast. Real construction cost inflation has a larger coefficient in the Southeast/Upper Midwest, and changes in lagged local prices work predominately in the other area.

Time Subsamples

While our data sample begins in 1977, taking first differences and allowing for lags has brought the effective start date to 1980. Thus we can't really examine the first subperiod listed in Tables 1 and 2. The results from estimating equations with and without the lagged dependent variable for the 1980-82, 1984-87, and 1988-91 subperiods are listed in Table 6 (note the deletion of 1983 discussed earlier). Given the short time series, we do not report estimates with different autoregressive parameters for individual cities. Instead we reported equations with and without the lagged dependent variable.

The explanatory power of our relationship, with or without the lagged dependent variable, is greatest in the last period. This may reflect improvement in the quality of the Freddie Mac data over time. All variables have the expected signs, 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 real 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.

IV. EXPLANATION OF REGIONAL REAL 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 (ten cities), the Upper Midwest and Southeast (UM&SE, 14 cities), New England (three cities) and Texas (two cities). Before discussing this table, Table 7 contains data on employment growth, real income growth, and real construction cost inflation, as well as real house price changes, 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 UM&SE), and declining real construction costs. The second period had strong income growth (especially in the Northeast but little in Texas), employment growth and rising real construction costs (again especially in the Northeast, but not in Texas). The most recent period has had negligible real income growth (expect in Texas), falling employment in the Northeast but rising in the rest of the country, and declining real construction costs. At the bottom of the table, we note that real after-tax interest rates fell in the first period, rose in the second, and then fell sharply in the third.[5]

We begin each part of Table 8 with actual real appreciation (average cumulative log difference across all cities) and then provide estimates based on the equations with the lagged dependent variable in Tables 4 (full sample), 5 (geographic split), and 6 (cycle split) -- equations

4.5, 5.1 and 5.3, and 6.2, 6.4, and 6.6. While the GLS 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 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 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. The regional SE/UMW estimate for the final period is worse than for the full sample because the former doesn"t 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 parts of the real house price changes in the various regions during the various time periods that can be explained by our preferred regression (equation 4.5) and indicates which variables account for the explanation. The first number, the actual change, and the second, the static "prediction" (labelled fitted change), are the same as those in Table 8. Also reported is the dynamic prediction, labelled 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").

Our ability to explain either the rapid real price increases in the Northeast during the middle 1980s and California during the late 1980s or the declines in Texas since 1983 is sharply reduced when we do not use observed lagged real house price inflation (expect for the first year of the cycle). Only a trival amount of these real price movements is explained, except for the extraordinary rise in the Northeast where 20 of the 58 point rise is accounted for. On the other hand, the two Upper Midwest/Southeast movements -- the decline in the 1980-82 recession and the rebound in the 1983-87 period -- are well explained. These areas include half of our cities. We also explain the run-up in California in the middle 1980s.

The contributions of the region specific variables are listed below the derived changes in the table. The contributions of changes in the real after-tax interest rate and of the constant, which are the same for all regions, are listed at the bottom of the table. Certainly the most important variables are the employment and real income growth rates. These are key to both the real price declines outside of the Northeast and the real rise in the Northeast during the 1979-82 period, and also to the real price increases outside of Texas in the middle 1980s. Construction costs matter, but only a little. Real 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 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 we noted when discussing the similarity between our results and the national estimates of Peek and Wilcox, our equation estimates seem to be driven more by time-series than by cross-section variation. This can be seen when we consider our ability to explain the diffences across regions for a given time span. In 1979-82, 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, we account for only 0.23 of a 0.79 difference (0.07 of 0.48 if Texas is excluded), and for the last period we account for but 0.02 of a 0.47 difference.

When we run equation 4.5 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 lagged dependent variable coefficient barely moves from 0.40 to 0.38. While these coefficient changes are significant, in total they don't increase our ability to explain the large real prices swings outside of the Upper Midwest/Southeast. 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.

V. CONCLUSION

Substantial movements in real house prices have occurred in various regions of the U.S. during various parts of the 1980s. In this paper we specify 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 is 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 only able to explain about two-fifths of real price changes. The explanatory power rises to above half when we add the lagged appreciation rate as an explanatory variable and to three-fifths with the inclusion of time period dummy variables.

Our explanatory power varies widely by region. For the half of our cities in the more stable Upper Midwest and Southeast, we explain virtually all of the real decline in the early 1980s and rebound in the middle 1980s. We also pick up the mid1980s 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, there may also be a data problem. Proposition 13 undoubtedly led many households to substantial rehabilitate their existing houses, rather than to trade up, in order to keep their property tax base down. When these properties finally traded in the late 1980s, the improvements were reflected in higher prices, i.e., part of the surge in "real prices" was likely an increase in quality.

Our inability to explain the sharp movements in the Northeast and the almost continual real decline in Texas is especially troublesome. Only a third of the extraordinary run up 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 simulated, lagged appreciation rate explains another quarter of the increase. But that isn't nearly enough. We speculate here that the extraordinary stock market rebound beginning in August 1982 had a disproportionately favorable impact on the Northeast because disproportionately large stock market wealth is held by residents of that region.

Texas is even more of a problem. Our data suggest positive real income and employment growth after 1983. In fact, the growth after 1987 is the strongest in the country. Possibly, like 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 result 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. We suspect, for example, that few Bostonians shifted to renting in 1987-88 and are now returning to owning.

We have both short and long run research agendas. As for the near term, we are searching for reasonable employment growth estimates for 1982-83 to eliminate the break in the data at that point and for some measure of growth restrictions or constraints on city expansion. We will also test deviations of real house price levels from their trend values, to see if there is a general tendency for real prices to revert to "normal" independently of the model variables. Finally, the hypothesis that recent real stock market capital gains affects the Northeast (and the energy price decline affects Texas) more than the rest of the country will also be tested.

In the longer run, our 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 one), 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.

ENDNOTES

1. See the January 1992 issue of Regional Science and Urban Economics for four critiques of Mankiw and Weil and their reply.

2. See their follow up paper 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.

3. Examination of the correlation matrix suggests the problem. The correlation of each of the change 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.

4. Unlike Case and Shiller, we do 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.

5. When we recompute the real after-tax interest rate 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.

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 there to be a constant real appreciation rate (using the local cpi less shelter) over the periods in question. These were 1977-80 in Boston, and 1980-84 in both Louisville and Minneapolis. This is equivalent to assuming there is no data 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 one of our discussants, 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 WRS indices used in this paper, by comparing them to "truth" as revealed by statistical derivations of the Joint Center. 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 1980-83 than the cpiu-x1, and 0.9 percent a year slower in 1983-87. The effect of these differences is to exacerbate the spread between the reported real Joint Center and WRS indices.

One issue of concern with the Freddie Mac series is the use of appraisals (from refinances) rather than only arms-length transactions for creation of the indices. Since refinances account for two-thirds of the matched-transaction dataset, 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 refinances for Anaheim, Boston and Detroit are virtually identical over 1977-91. There is a slight pattern of differences over the 15 years: the indices without refis grew a little more slowly in 1979-82, more quickly in 1983-87, and more slowly 1987-91.

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 on nominal expenditures on home improvements is the four Census region level reported in the Census 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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TABLE 1
HOUSE PRICE APPRECIATION
FOR SELECTED METROPOLITAN AREAS AND TIME PERIODS
(Annualized Percent Change)

	1977–80	1980–83	1983–87	1987–91	1977–91
EAST					
Northeast	**12.0**	**11.7**	**19.3**	**0.2**	**10.4**
Boston	14.3	11.0	20.0	−0.3	10.8
Nassau–Suffolk	9.1	17.1	18.7	0.4	10.8
Newark	12.8	7.1	19.2	0.5	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
Cincinatti	10.2	1.1	4.0	6.0	5.2
Cleveland	7.1	0.8	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**	**−0.5**	**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	0.4	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:					
U.S. Consumer Prices	9.2	6.6	3.3	4.6	5.6

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TABLE 2
REAL HOUSE PRICE APPRECIATION
FOR SELECTED METROPOLITAN AREAS AND TIME PERIODS
(Annualized Percent Change)

	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	0.6	10.3	15.0	−4.0	5.2
Newark	4.1	0.8	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	−0.1
Baltimore	1.1	−2.2	4.2	3.5	1.9
Charlotte	4.6	−2.4	3.2	0.3	1.4
Richmond	0.4	−2.7	1.8	0.7	0.2
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	0.7	0.2
Chicago	3.0	−4.9	3.9	3.1	1.0
Cincinatti	5.6	−5.3	1.6	1.8	0.2
Cleveland	2.0	−6.4	1.5	2.4	−0.5
Columbus	3.2	−4.0	2.0	1.1	0.2
Detroit	10.5	−7.1	3.8	2.8	1.2
Kansas City	7.3	−4.0	0.8	−2.8	−0.7
Louisville	4.0	−3.6	0.8	0.2	−0.3
Minneapolis	10.4	−3.1	1.6	−1.0	0.7
St. Louis	8.2	−4.3	2.7	−1.8	0.1
Texas	8.8	−1.0	−5.1	−4.5	−1.9
Dallas	11.4	−0.8	−0.2	−7.0	−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	−0.7	1.3	6.4	3.3
Los Angeles	9.1	−2.3	3.1	7.9	4.5
Riverside–SB	7.2	−3.0	0.7	6.0	2.7
San Diego	7.4	−3.9	2.4	5.7	3.0

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Table 3: Explaining Five-Year Changes in Real House Prices*

Equation	3.1	3.2	3.3	3.4	3.5	3.6
Constant	-0.045 (-1.8)	-0.098 (-3.5)	0.107 (2.0)		-0.057 (-0.8)	-0.023 (-0.3)
Change in Real Land Costs	0.166 (1.9)	0.409 (4.9)	0.328 (4.6)	0.384 (5.6)	0.281 (2.6)	0.128 (1.2)
Change in Real Construction Costs			2.361 (4.3)	1.356 (5.5)	2.104 (2.6)	0.098 (0.1)
R^2	0.10	0.42	0.63	0.58	0.52	0.10
Number of Observations	33	35	35	35	17	17

*Both the dependent and real construction cost variables are lowered by one percent annually.

Table 4: Total Sample Estimates

Equation	4.1	4.2	4.3	4.4	4.5	4.6
Constant	-0.008 (-2.5)	-0.010 (-2.8)	-0.006 (-1.7)	-0.007 (-2.2)	-0.006 (-2.1)	-0.001 (-0.4)
Real Construction Cost Inflation	0.541 (4.4)	0.581 (4.7)	0.552 (4.6)	0.468 (4.2)	0.457 (4.2)	0.579 (5.7)
Employment Growth	0.515 (4.2)	0.465 (3.9)	0.496 (4.2)	0.342 (3.1)	0.313 (3.2)	0.367 (3.6)
Real Income Growth	0.835 (5.2)	0.866 (5.5)	0.603 (3.8)	0.581 (4.0)	0.565 (4.4)	0.433 (3.3)
Change in Real After Tax Interest Rate						
7 Year	-0.604 (-2.9)					
1 Year		-0.502 (-3.0)	-0.578 (-3.4)	-0.542 (-3.5)	-0.593 (-4.4)	-0.606 (-5.5)
Change in Employment Growth	-0.158 (-1.6)	-0.113 (-1.1)	-0.144 (-1.3)	-0.061 (-0.6)		
Change in Real Income Growth	-0.556 (-3.7)	-0.520 (-3.4)	-0.384 (-2.5)	-0.078 (-0.5)		
Change in Local Price Deviation			-0.230 (-4.8)	-0.076 (-1.5)	-0.072 (-1.5)	-0.172 (-4.6)
Lagged Real Appreciation				0.392 (7.9)	0.402 (8.7)	
R^2	0.39	0.39	0.43	0.53	0.54	0.38
Number of Observations	319	319	319	319	319	319

Table 5: Regional Sample Estimates

	West, Northeast and Texas		Southeast and Upper Midwest	
Equation	5.1	5.2	5.3	5.4
Constant	-0.000 (-0.0)	0.015 (2.0)	-0.009 (-3.1)	-0.006 (-2.2)
Real Construction Cost Inflation	0.325 (1.6)	0.229 (1.4)	0.433 (3.6)	0.564 (5.3)
Employment Growth	0.497 (2.9)	0.598 (2.8)	0.040 (0.3)	0.100 (1.1)
Real Income Growth	0.454 (2.5)	0.255 (1.2)	0.989 (5.9)	0.832 (5.9)
Change in Real After Tax One-Year Rate	-0.424 (-1.5)	-0.690 (-2.6)	-0.603 (-4.5)	-0.527 (-4.9)
Change in Local Price Deviation	-0.152 (-2.0)	-0.261 (-4.1)	-0.000 (-0.0)	-0.103 (-2.4)
Lagged Dependent Variable	0.443 (6.3)		0.230 (3.6)	
R^2	0.46	0.27	0.62	0.64
Number of Observations	65	65	54	54

Table 6: Period Sample Estimates

	1980-82		1984-87		1988-91	
Equation	6.1	6.2	6.3	6.4	6.5	6.6
Constant	-0.019 (-4.6)	-0.018 (-4.5)	0.006 (0.8)	0.003 (0.6)	0.004 (0.4)	-0.014 (-1.6)
Real Construction Cost Inflation	0.380 (2.8)	0.390 (3.9)	0.827 (6.5)	0.501 (4.3)	0.921 (3.3)	0.779 (3.0)
Employment Growth	0.689 (7.2)	0.596 (3.9)	0.007 (0.1)	0.058 (0.5)	1.170 (7.5)	0.960 (5.5)
Real Income Growth	-0.067 (-0.5)	-0.018 (-0.1)	0.573 (3.0)	0.538 (3.4)	0.261 (1.1)	0.330 (1.4)
Change in Real After Tax One-Year Rate	-1.252 (-4.5)	-1.168 (-3.9)	-0.103 (-1.0)	-0.256 (-2.9)	-1.769 (-3.7)	-2.038 (-4.7)
Change in Local Price Deviation	-0.201 (-3.2)	-0.177 (-2.6)	-0.054 (-1.0)	0.209 (3.6)	-0.437 (-5.4)	-0.310 (-3.8)
Lagged Dependent Variable		0.077 (0.8)		0.570 (7.6)		0.304 (4.0)
R^2	0.49	0.51	0.40	0.59	0.65	0.65
Number of Observations	87	87	116	116	116	116

Table 7: Variations in Determinants of Regional Real House Price Changes over Selected Periods (cumulative log changes)

	1979-82	1983-87	1987-91
Northeast			
Employment Growth	0.025	0.114	-0.066
Real Income (per adult) Growth	0.027	0.161	0.007
Real Constr. Cost Inflation	-0.033	0.066	-0.037
Actual Real Price Growth	0.109	0.576	-0.184
California			
Employment Growth	0.031	0.187	0.091
Real Income (per adult) Growth	-0.087	0.103	-0.005
Real Constr. Cost Inflation	-0.009	0.025	-0.074
Actual Real Price Growth	-0.014	0.104	-0.280
Texas			
Employment Growth	0.132	0.053	0.108
Real Income (per adult) Growth	-0.040	0.011	0.046
Real Constr. Cost Inflation	-0.020	-0.040	-0.095
Actual Real Price Growth	-0.070	-0.215	-0.188
Southeast and Upper Midwest			
Employment Growth	-0.040	0.156	0.052
Real Income (per adult) Growth	-0.051	0.118	0.019
Real Constr. Cost Inflation	-0.041	0.025	-0.069
Actual Real Price Growth	-0.134	0.096	0.032
Change in RAT Interest Rate	-0.013	0.019	-0.042

Table 8: Actual and Forecast Real Price Growth
(Simple average of total log change by city)

	1979-82	1983-87	1987-91
Northeast (3 cities)			
Actual	0.109	0.576	-0.184
Full sample	0.017	0.334	-0.039
Region sample	0.048	0.384	-0.051
Time sample	-0.018	0.400	-0.127
Southeast & Upper Midwest (14 cities)			
Actual	-0.134	0.096	0.032
Full sample	-0.112	0.116	0.028
Region sample	-0.110	0.096	-0.003
Time sample	-0.100	0.105	0.037
Texas (2 cities)			
Actual	-0.070	-0.215	-0.188
Full sample	-0.019	-0.069	-0.103
Region sample	0.014	-0.033	-0.077
Time sample	0.003	-0.057	-0.033
California (10 cities)			
Actual	-0.014	0.104	0.280
Full sample	-0.027	0.118	0.134
Region sample	0.004	0.171	0.191
Time sample	-0.041	0.100	0.165

Table 9: Decomposition of Forecast Real Price Growth

	1979-82	1983-87	1987-91
Northeast			
Actual Change	0.109	0.516	-0.184
Fitted Change	0.017	0.334	-0.039
Derived Change	-0.003	0.198	-0.012
Real Constr. Cost Inflation	-0.027	0.042	-0.021
Employment Growth	0.010	0.053	-0.011
Real Income Growth	0.022	0.128	0.021
Local Price Dev. & Lagged Dep.	0.005	0.023	0.004
Southeast and Upper Midwest			
Actual Change	-0.134	0.096	0.032
Fitted Change	-0.112	0.116	0.028
Derived Change	-0.093	0.132	0.010
Real Constr. Cost Inflation	-0.024	0.011	-0.039
Employment Growth	-0.009	0.070	0.028
Real Income Growth	-0.039	0.095	0.020
Local Price Dev. & Lagged Dep.	-0.010	0.004	0.004
California			
Actual Change	-0.014	0.104	0.280
Fitted Change	-0.027	0.118	0.134
Derived Change	-0.059	0.130	0.015
Real Constr. Cost Inflation	-0.008	0.011	-0.045
Employment Growth	0.017	0.084	0.047
Real Income Growth	-0.059	0.082	0.003
Local Price Dev. & Lagged Dep.	0.005	0.002	0.014

	1979-82	1983-87	1987-91
Texas			
Actual Change	-0.070	-0.215	-0.188
Fitted Change	-0.019	-0.069	-0.103
Derived Change	0.002	-0.027	-0.002
Real Constr. Cost Inflation	-0.015	-0.030	-0.057
Employment Growth	0.059	0.031	0.049
Real Income Growth	-0.028	0.016	0.040
Local Price Dev. & Lagged Dep.	0.008	0.004	-0.031
Common Variables			
RAT Interest Rate	0.011	-0.014	0.030
Constant	-0.024	-0.034	-0.034