Housing Trends in the 1990s: The Effects on Rent Inflation and Its Measurement in the CPI*

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Abstract

Some commentators have argued that the rate of increase of the tenant rent and owners' equivalent rent (OER) components of the CPI over the past several years have been implausibly low given an otherwise robust housing market. This paper compares CPI tenant rent and OER inflation with counterpart measures derived from the American Housing Survey (AHS). Ironically, these AHS based measure of rent inflation, while following the same general pattern, are even lower than those of the CPI. The main source of these lower estimates of rent inflation is that we find that the rate of rent increases is inversely related to the level of monthly housing cost, and our methodology appears to give greater weight to the upper end of the owner-occupied housing market. The main reason for the inverse relationship between that the rate of rent increases and the level of monthly housing cost appears to be that the production of new housing over the past decade was heavily skewed toward meeting demand at the upper-end of the housing market. In contrast, downward filtering was relatively more important in meeting the increase in demand at the lower-end of the housing market. Thus, more elastic supply at the top than at the bottom could explain the pattern of rent increases.

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Introduction

The single largest item in most household budgets is mortgage or rent payments. Accordingly, "shelter" is the largest component of the consumer price index (CPI), with a relative importance, or weight, of 30 percent (Table 1).[1] Within shelter, the two largest items are owner's equivalent rent (OER), which is the rent that homeowners implicitly pay themselves, and tenant rent, which is the rent that tenants pay landlords. With their large relative importance, the inflation rates for OER and tenant rent exert considerable influence on overall and core CPI inflation.[2] As a result, substantial attention is paid to the estimation and behavior of these two series.

Over the past decade various indicators of the housing market have given quite different pictures of the balance between supply and demand and so the likely course of rent inflation. For example, from the mid-1990s onward, the turnover rate of single-family homes—the ratio of existing home sales to the stock of homes—rose fairly steadily (Chart 1). At the same time, home price appreciation—measured by a repeat-sales index compiled by the Office of Federal Housing Enterprise Oversight (OFHEO)—rose quite dramatically. Construction of new homes was strong, and there were many reports of rapid increases in rents in parts of the country. These developments suggest strong demand relative to supply with increasing rent inflation.

However, other indicators suggested that at least some parts of the housing market were relatively weak. For example, the vacancy rate for single-family rental units rose from around 4 percent in the early 1990s to about 9 percent in early 2004 (Chart 2). Vacancy rates for multifamily rental units were relatively stable at high levels through much of the 1990s, then shot up from 2000 through 2003. These trends in vacancy rates suggest that supply was rising relative to demand, putting downward pressure on rent inflation.

To further confuse matters, rent inflation as measured by the CPI was quite erratic over this period. For instance, from late 1996 through late 1998, both OER and tenant rent inflation increased (Chart 3). Then during 1999, both rates slowed, more than accounting for the slowing

in core CPI inflation that year—a phenomenon that many commentators found implausible in a strong housing market.[3] Beginning in 2000, both OER and tenant rent inflation increased again, but with tenant rent inflation greater than OER inflation—a reversal of the relationship that existed in the first half of the 1990s. This erratic behavior was likely due in part to the fact that the U.S. Department of Labor's Bureau of Labor Statistics (BLS)—the government agency that produces the CPI—made significant changes in its methodology for estimating OER inflation in 1999 as well as the volatility of energy prices.[4]

Given the concern about how the CPI measures changes in rent and OER, an alternative source of data would be a useful benchmark. Fortunately, and unlike for most other categories of goods and services, a readily available alternative for housing data exists—the American Housing Survey (AHS). In this article, we use the AHS data to construct alternative OER and tenant rent measures and compare them with those from the CPI. We also use these data for a more detailed analysis of the trends in the housing market to help explain the differences between the CPI and our AHS-based measures.

Our alternative measures of OER and tenant rent inflation follow a pattern similar to the CPI measures—slowing from the early to the mid-1990s and then accelerating from the mid-1990s to 2001. However, our alternative measures of tenant rent inflation, and particularly OER inflation, are substantially lower than the CPI measures over our sample period.

The latter result is driven by the fact that we find an inverse relationship between the level of housing costs and changes in rent during this period. This relationship exists despite data suggestive of a positive relationship between the change in rent and the level of housing costs. These include: real income growth positively related to income levels; rental vacancy rates inversely related to housing costs levels; and larger percentage increases in homeownership rates, which might depress the demand for rental housing, for lower income households than for higher income households.

Although a definitive answer is beyond the scope of this paper, we present evidence that suggests that the answer to this riddle lies in the supply side of the housing market. Construction of new housing over the past decade has been heavily skewed toward meeting demand at the upper end of the housing market, whereas downward filtering of formerly higher-end homes was relatively more important in meeting demand at the lower end. This suggests that supply was more elastic at the top than at the bottom, which in turn implies that rent increases could be more subdued at the upper end.

The article is organized as follows: we first review BLS procedures for estimating OER and tenant rent inflation. We then describe the AHS data and the methods used to construct our alternative rent inflation measures. Next, we compare our AHS based measures of tenant rent and OER inflation with the CPI measure. Finally, we discuss the trends in the housing market that likely contributed to the different results produced.

Estimation of OER and Tenant Rent Inflation in the CPI

It is helpful to begin by providing a brief history and description of the methods used by BLS to estimate the price indexes for tenant rent and OER.[5] Tenant rent is a reasonably straightforward concept—it is directly observable and has always been included in the CPI. The data collected by the CPI on each rental unit in its housing survey include contract rent, rent adjustments (government subsidies or credits for tenant-provided services), and physical characteristics.[6] From this information, the BLS derives the unit's "economic rent." Economic rent is contract rent adjusted for rent subsidies and changes in landlord-provided services, to account for quality changes that should not be reflected in the measure of price change. It should be noted that in some cases contract rent includes utilities. The cost of utilities not included in contract rents is reflected in the fuels and utilities subcomponent of the overall housing category of the CPI (Table 1). The economic rents of the sampled units are then aggregated to obtain the CPI rent index.

The measurement of the price of housing services provided through homeownership is less straightforward because implicit rents are not observed market prices. Furthermore, its treatment in the CPI has changed several times in the past two decades. Prior to 1983, the BLS used an "asset price" approach that measured the cost of buying a home. This involved tracking home prices and financing costs, analogous to the CPI's current treatment of automobiles and other consumer durables. However, in the late 1970s and early 1980s, when home prices and mortgage interest rates were rising rapidly, the asset price approach came under severe criticism. Under those circumstances, it became clear that this approach overstated inflation of housing services because it could not separate the investment aspect of homeownership, which is beyond the scope of the CPI, from the consumption of housing services.

In response, in 1983 the BLS adopted the "rental equivalence" approach, which is designed to measure the change in homeowners' implicit rents. Implicit rent is the amount for which a homeowner could rent his home to someone else or, alternatively, the amount the homeowner would have to pay on the rental market for the services provided by his home. Implicit rent is not observable and must therefore be estimated. The manner in which it has been estimated in the CPI has changed over time.[7]

From 1983 through 1986, the change in OER was calculated using the tenant rent sample. Rental units in areas with a high proportion of owner-occupied units were given more weight in this calculation. From 1987 through 1998, the BLS used a split-sample approach: it expanded the CPI housing sample to include owner-occupied units as well as rental units and linked each sample owner unit with two or more rental units with similar locational and physical characteristics. It then estimated the change in OER for the owner unit using the change in the rents of the matched rental units. In 1995, the BLS made some technical changes that reduced the rate of increase in OER by 0.4 percentage point per year.[8]

The split-sample approach was costly, however, as it required a sample of owner units, while rental units with characteristics similar to those of owner units had to be oversampled to

provide sufficient matches to owner units. Moreover, BLS research indicated that this method was not improving the estimates of rent inflation.[9] So, beginning with the publication of the January 1999 CPI, the BLS returned to estimating the change in OER based on a reweighted sample of rental units. However, the BLS made a number of technical changes that it believed would reduce many of the then-known biases in measuring shelter prices (Moulton 1997).

We explain the current methodology for estimating tenant rent and OER inflation from a single sample of rental units in more detail in a box. The box also discusses circumstances in which the estimated price changes may differ from the true ones. One important note is that because tenant rent is observed while owner's equivalent rent is not, errors are more likely to occur with OER than with tenant rent.

Key potential sources of error lie in two areas. First, the level of OER in the base period is estimated as a nonlinear function of property values, derived from data on tenant rents and property values in census blocks. Errors in the estimation of the level of OER would result in incorrect renter's and owner's weights and produce errors in both price series. Second, the true rate of change of OER in a segment may not be the same as the observed rate of change of tenant rents in that segment, resulting in errors in the estimated change in OER. Both of these potential sources of error are more likely to occur in segments with relatively few rental units, which appears to be the case in much of the upper half of the owner-occupied housing market.

Another issue that has received attention recently is the treatment of utilities in the estimation of OER from tenant rents (Ip 2003). As presented in the CPI, OER excludes utilities yet is estimated from tenant rents that in some cases include utilities. Therefore, before estimating the change in OER, the BLS makes adjustments to changes in tenant rents that include utilities to eliminate the effect of changes in the cost of utilities on the changes in rent. This adjustment results in a strong inverse relationship between the rate of increase in OER and the rate of increase for the fuels and utilities subcomponent of shelter.

Some argue that this adjustment is inaccurate because in many, if not most, cases where utilities are included in rents, rents are not adjusted for changes in utilities except, perhaps, when a lease is renewed or a new tenant occupies the unit. Short-term changes in the cost of utilities covered by the contract rent would be absorbed by the landlord. In response to this argument, it should be noted that the current BLS methodology observes changes in rents over a six-month interval, and then converts them to monthly changes. This increases the likelihood that the observed rent change reflects, at least in part, changes in the cost of utilities.

Data and Methodology Used for Alternative Measure of Rent Inflation

To calculate alternative rent inflation series, we use the national samples of the American Housing Survey for the years from 1989 through 2001. The AHS, conducted by the U.S. Department of Housing and Urban Development in odd-numbered years, is a sample of about 50,000 units weighted to represent the U.S. housing stock. The AHS is a good source of information about trends in the housing market and rent inflation because it collects information about units' physical characteristics, location characteristics, housing costs, values for owner-occupied homes, and other useful information.

Summary measures from the AHS provide an interesting overview of the housing stock of the United States. In 2001, there were 116.1 million housing units intended for year-round use. More than two-thirds of that total consisted of single-unit structures, of which almost 80 percent were owner occupied (Table 2). In contrast, more than three-quarters of the units in multifamily (five or more units) structures, which made up 16.3 percent of the stock in 2001, were renter occupied. As for the remainder of the stock, two-to-four-unit structures accounted for almost 8 percent of the stock and were mostly renter occupied, while mobile homes made up just more than 7 percent and were mostly owner occupied.

A significant fraction of units are vacant at any time. Many reasons for vacancies exist, ranging from units for sale or rent to units held for occasional use, such as second homes. For

rental units, the aggregate vacancy rate in 2001 based on AHS data was 7.8 percent, ranging from 6.6 percent for single-family units to 10.5 percent for mobile homes.[10]

Examining the changes in the housing stock, we observe that its growth over the past decade has been concentrated in single-family, owner-occupied homes. From 1993 to 2001, the housing stock grew at an annualized rate of 1.44 percent, compared with the 1.45 percent growth rate of households (Table 3).[11] The number of mobile homes and single-family units grew rapidly while the number of structures with five or more units grew slowly and the number of structures with two to four units declined. Single-family units accounted for about 90 percent of the increase in the housing stock over this period because of their large numbers and rapid growth rate. Furthermore, with housing stock growth concentrated in owner-occupied units, the homeownership rate—the percentage of occupied housing units that are owner occupied—increased from 64.7 percent in 1993 to 67.9 percent in 2001.[12]

Estimating Tenant Rent Inflation

To calculate our alternative series on change in tenants' rent, we use the AHS monthly housing cost variable for renters, which includes utilities for those units where contract rent excludes utilities. We do this because of the difficulty in measuring utility costs for those units that have utilities included in the rent.[13] We use these data to construct two time series of tenant rent inflation. The first series, which we call AHS raw data, is based on the change in rent of the same units over two-year intervals. We thus end up with six panels of units—1989-91, 1991-93, 1993-95, 1995-97, 1997-99, and 1999-2001. For each panel, we compute a weighted-average rent change using the AHS weights and the level of housing costs for each unit from the first period of the panel to compute housing expenditure weights, as is now done in the CPI. This approach does not address the possibility that the quality of units may have changed over the two years, which might have had an effect on the measured change in rent.

The second AHS based tenant rent inflation series is based on a pooled time series, cross section regression of change in rent. The explanatory variables and the results of that regression are shown in Table 4. After substantial experimentation, we found that the log level of housing cost and geographic location were the primary determinants of the change in rent. This is consistent with BLSs' findings, mentioned in endnote #8. Note that the sign of the coefficient on the log of housing cost term is negative, indicating that the change in rent declines as the level of housing cost increases.[14] With regard to the effect of changes in the quality of a housing unit, we found that a change in the square footage of a rental unit and a change in the occupant's assessment of the neighborhood were directly related to the change in rent. However, a change in the assessment of physical adequacy did not have a statistically significant relationship to change in rent.

To compare these AHS-based tenant rent inflation series with a comparable CPI-based series, we must first construct a CPI series that includes utilities for all units. Our method of doing this is presented in Table 5. Columns 1 and 2 present the annualized percent changes of tenants rent and utilities from the CPI for the relevant two year intervals. Columns 3 and 4 present the averages of utilities as a percent of total housing costs for all rental units and of the percent of rental units where utilities are not included in rent, both from the AHS. Columns 5 and 6 are the averages of those percentages for the two-year intervals. Finally, column 7 presents the weighted average percent change of rent and utilities, derived by the formula presented at the bottom of that table.

Chart 4 compares our two AHS-based measures of tenant rent inflation with that of the CPI. The first thing to note is that both of our estimates are less than the CPI estimate, in some years by a substantial amount.[15] But while lower, the AHS rent changes follow a similar pattern as the CPI rent changes. That is, both slow from the early to mid 1990s and then begin to increase again at the end of that decade. Another finding from the AHS data is that over the

period from the late 1980s to around the mid 1990s it appears that the quality of the rental stock was declining while in the later half of the decade the quality of the rental stock was improving.

Estimating OER Inflation

To estimate the change in OER using the AHS data, we attribute changes in rents of rental units to owner occupied units. The first and most crucial step in this exercise is to assign a value of monthly housing cost to each owner-occupied unit in our panels. Although the AHS contains a monthly housing cost variable for owner-occupied units, this variable does not include the opportunity cost of the homeowner's equity, depreciation, or expected change in property value, thus making it incompatible with the renter's housing costs. Therefore, we construct an estimate of owners' monthly housing costs based on a user cost of capital concept.

The first component is the cost of capital, which we measure as the estimated value of the property multiplied by the prevailing yield on mortgage-backed securities. To this we add real estate taxes as reported in the AHS. Both the opportunity cost of capital and property taxes are then expressed on an after-tax basis by multiplying them by one minus the marginal federal income tax rate likely faced by the owners of that housing unit. The marginal tax rate is determined by estimating the owner's taxable income based on the AHS reported gross income, assuming that each taxpayer files a joint return and has two children. To after-tax opportunity cost and property taxes we add utilities, insurance, and maintenance costs, as reported in the AHS, plus depreciation assumed to equal one percent of the value of the structure (75 percent of total property value). Finally, from that sum, we subtract the expected annual change in property value, estimated as one-half the change in the owner's estimate of the value of the property over the two years of the panel. This annual housing cost is then converted to a monthly cost by dividing by 12.

With this estimated housing cost we assign changes in rent to owner occupied units based on the regression presented in Table 4. We then compute an aggregate percent change for

all owner occupied units using housing expenditure weights, as mentioned in the discussion of the aggregate change in tenant rent. Finally, since our AHS tenant rents include utilities, we construct a comparable CPI series by taking a weighted average of the CPI estimate of the change in OER and the change in utilities using weights for homeowners based upon the AHS.

The results, shown in Chart 5, are qualitatively similar to the results for tenant rent. That is, over the entire period, the pattern of our AHS-based estimates of the change in OER is similar to that of the CPI in that they slow over the first half of the decade but then accelerate in the second half. However, the AHS based estimates of the change in OER are consistently lower than the CPI estimates. Over the period from 1989 to 1991 the AHS estimate is substantially lower—about 3.8 percentage points—but by the 1997 to 2001 period the difference declines to about 0.9 percentage points.

Why the Differences?

Ironically, while many people have been arguing that the rent inflation measures in the CPI have been implausibly low, our alternative AHS-based estimates are even lower. What is driving this result? We first address that question from a computational perspective. We then address it from the perspective of the dynamics of the housing market, which is both more difficult and speculative.

Recall that under current BLS methodology, the aggregate change in both tenant rent and OER is the weighted average of rent changes of individual units in the sample of rental units, with weights based on shares of aggregate rental and owner expenditures, respectively. Since we mimic BLS methodology to a large extent, differences between our estimates and those of the CPI are due to some combination of different rent changes from the sampled rental units and different weights applied to those rent changes. Table 6 presents annualized rent changes of rental units from our six AHS panels for monthly housing cost quintiles, with quintiles based on number of units. Rent changes for the top 10 percent and 5 percent are also

presented. Note that within each quintile the pattern of rent changes is similar and is essentially the same as the aggregate CPI tenant rent and OER estimates--slowing from the early to the mid 1990s and then accelerating from the mid 1990s to the end of the period. Note also that, as mentioned above, the change in rent for rental units is inversely related to the level of monthly housing costs. The difference in annualized rent increases between the first and fifth quintiles is largest for the 1991-1993 panel—3.8 percentage points—and progressively narrows to 2 percentage points in the 1999-2001 panel. The aggregate estimates that we derive correspond to the rent changes of the second quintile. In contrast, the CPI estimates correspond more closely to some combination of the third through fifth quintiles.

For OER, another factor likely contributing to our lower estimates of aggregate change is the fact that we assign rent changes to owner units based on the regression presented in Table 4. In contrast, BLS methodology for estimating OER is to apply the expenditure weights of the owner distribution to the rent changes actually observed in the renter distribution. To see why this is likely to be an important issue, Chart 6 presents the 2001 distributions of rental and owner units by monthly housing cost based on the AHS.[16] The upper tail of the distribution of rental units corresponds to just the median of the distribution of owner units. Given the inverse relationship between change in rent and the level of monthly housing cost, it is quite likely that the rent changes we assign to the right tail of the owner distribution are much smaller than the rent changes assumed in the BLS methodology. (This is a critical issue particularly when you consider those distributions in terms of expenditure weights.)

If rent changes were fairly uniform across the distribution of rental units, none of this would be an issue. However, the AHS data reveal an inverse relationship between rent change and the level of monthly housing cost, which is surprising given what we know about income growth and rental vacancy rates. As shown in Table 7, during the 1990s incomes of higher income households grew faster than did the incomes of middle and lower income households.

And for the period from 1989 to 1995 rental vacancy rates were the highest for the lowest monthly housing cost quintile and then declined as housing cost increased (Table 8).[17]

To investigate the source of this inverse relationship between rent increases and the level of housing costs, we examine the dynamics of the housing stock over the 1990s. To do so, we divide the 1989 stock of occupied housing units into quintiles based on the reported household income (quintile 1 is the lowest income quintile while 5 is the highest). We then bring forward to 2001 the boundaries of the quintiles, using the personal consumption expenditures deflator to inflate the incomes so that real incomes remain the same. Looking at how this distribution evolved, we observe that the share of households in the lowest and highest income groups increased while the share for the middle-income groups declined (Table 9). This is consistent with what is known about the evolution of the income distribution over this period. Also note that the share of the highest quintile for owner-occupied homes rose strongly.

We next look at the sources of the change in the number of homes in each income quintile. The sources include net filtering (movement between income groups), new construction, and the residual, which we interpret as the net of conversions from nonresidential to residential use and losses. The AHS data indicate substantial net filtering of housing units, with units from middle-income groups toward the lowest and highest quintiles (Table 10). Note that net filtering comprises a larger share of the increase in housing units for the lowest quintile than for the highest quintile. In contrast, new construction and net conversions are heavily skewed toward upper income groups—about 60 percent of new construction and 75 percent of net conversions expanded the housing stock occupied by households in the highest two income groups. This was especially true for owner-occupied homes.

These patterns suggest that one potential explanation for the inverse relationship between rent increases and the level of housing costs is simply that the supply of new housing has been concentrated at the upper end. As such, this new supply would tend to hold down rent inflation for competing units, holding all else the same. At the same time, a relatively high

fraction of the increase of the housing stock in the lowest income group has resulted from downward filtering. Such housing may be of better quality than what it is replacing through demolition and other losses, but it may also be more expensive. This may help explain both the higher rent increases and higher vacancies in that income category.

Conclusion

Citing the strength in many housing market indicators, several commentators have questioned the plausibility of the relatively low tenant rent and OER inflation published in the CPI in recent years. Ironically, our alternative measures of tenant rent and owner's equivalent rent inflation for the period from 1989 to 2001, compiled from data in the American Housing Survey, are even lower than those reported in the CPI. The computational reason for this result appears to be that rent increases decline as the level of monthly housing cost increases, and our methodology gives more weight to the upper tail of the housing distribution, particularly for owner-occupied units. The economic reason appears to be that the elasticity of supply of new housing increases with the income level of the intended market for that housing.

Given the complexity of this issue, the gaps in the AHS data set, and the relative crudeness of our estimation procedure, we cannot argue that our estimates are more accurate than those published in the CPI. In fact, our estimates lend support to the CPI estimates in that they suggest that the CPI estimates are not implausibly low, as some have suggested. However, our analysis does point to a possible improvement in the CPI methodology. Much like the Survey of Consumer Finances, in which the upper end of the income distribution is disproportionately influential in aggregate income and wealth statistics, the BLS may want to consider oversampling the upper end of the housing market. The BLS's current procedures, which use expenditures in a segment to determine a segment's sampling probability, have moved in this direction. Still, an explicit sample of high-end units may be necessary to obtain a more accurate reading of aggregate changes in rents.

Box

The current BLS methodology for estimating both tenant rent and OER inflation begins with the CPI Housing Survey, a sample of about 40,000 housing units drawn from the Census of Population and Housing. This sample is selected from eighty-seven primary sampling units (PSUs), of which seventy-seven are metropolitan areas and ten are nonmetropolitan areas. Each PSU is divided into six strata. In metropolitan areas, two strata typically encompass the central city and the other four the surrounding suburban areas. The strata are then divided into segments, which are small groups of census blocks.

Segments are the fundamental units for sampling and weighting. A segment's probability of being selected is proportional to its size, where size is measured by aggregate housing expenditures within the segment.[11] Aggregate housing expenditure is derived as (number of renters) x (average rent) + (number of owners) x (average implicit rent). The raw weight for each segment is the inverse of this probability.[a] This raw weight is then modified to create specific weights for determining the change in tenants rent (renters' weight) and for determining the change in OER (owners weight). The raw weight is first multiplied by the ratio of total housing units in a segment over the number of sampled units from that segment (HU/SU). Then that product is multiplied by the ratio of renters' costs (RC) over total housing expenditures (TC) for the segment, to create the renters weight, or the ratio of owners' costs (OC) over total housing expenditures (TC) for the segment, to create the owners' weight. The renters' and owners' weights are then given by:

*renters' weight = raw weight * (HU/SU) * (RC/TC)*

*owners' weight = raw weight * (HU/SU) * (OC/TC).*[b]

These weights are based on base year housing expenditures.

The estimated price change for rent (π^R) then is the change in the weighted average rent of sampled rental units, and the price change for owner's equivalent rent (π^{OER}) is the change in the weighted average rent of sampled rental units using the owner weights:

$$\pi^{R} = 100 * \left[\frac{\sum_{i} (renters'\ weight)_i\, rent_{i2}}{\sum_{i} (renters'\ weight)_i\, rent_{i1}} - 1 \right]$$

$$\pi^{OER} = 100 * \left[\frac{\sum_{i} (owners'\ weight)_i\, rent_{i2}}{\sum_{i} (owners'\ weight)_i\, rent_{i1}} - 1 \right]$$

The accompanying table provides a hypothetical example of this procedure and also illustrates some circumstances where the procedure may yield inaccurate estimates. In this example, we assume that the universe consists of twenty geographic segments, each of which has 250 housing units. We further assume these twenty segments are divided into equal numbers of Type 1 segments, that have primarily owner-occupied units and relatively high rents, and Type 2 segments, that have primarily renter-occupied units and lower rents.

A sample of three segments is chosen to calculate the OER and tenants rent price indexes. The observed rents and unobserved implicit rents in each segment are assumed to be equal. Rent levels in Type 1 segments are double those in Type 2 segments, so Type 1 housing expenditures are double those of Type 2 segments. Since the probability of a segment being selected in the sample depends upon total housing expenditures, the sample includes two Type 1 segments and one Type 2 segment. A segments housing expenditures divided by the total housing expenditures of the universe determines that segments probability of selection, and the inverse of that probability is the segments raw weight. Since each segment has 250 housing units, and a sample of 25 units is drawn from each sampled segment, the ratio HU/SU is equal to 10 for each sampled segment.

From period 1 to period 2, observed tenants rents are assumed to increase 4 percent in Type 1 segments and 2 percent in Type 2 segments. We shall also assume for the sake of this example that unobserved owner equivalent rents in each segment rise by the same percentage as observed tenants rents. Under this rather long list of assumptions, the estimated increases in tenants' rent and OER are equal to the actual increases for the entire universe.

Of course, whenever estimates are derived from a sample there is the risk of sample bias. But beyond sample bias, this example illustrates situations where the estimated price changes may differ from the true ones. Moreover, since tenant rents are observed while owner equivalent rents are not, errors are more likely for OER than for tenants' rent. For example, the level of OER is not observed but rather estimated as a nonlinear function of property value. Errors in this step of the methodology would result in incorrect renters' and owners' weights. In addition, OER in one or more of the sampled segments may not change at the same rate that sampled tenants rents change, resulting in errors in the estimated change in OER.

[a] This is a technical change introduced in 1999. During the 1983-87 period, this raw weight was based on the number of housing units, rather than total housing expenditures. In practice, implicit rents in a segment are estimated using a nonlinear regression relating rents in census blocks within a metropolitan statistical area with home values.

[b] The original version of Ptacek and Baskin (1996) had an error in these formulas, which has been corrected in the version posted on the Bureau of Labor Statistics web site. Despite the error, consumer price index (CPI) calculations have used the correct formulas presented here.

REFERENCES

Armijo, Gretchen A., David W. Berson, Mark H. Obrinsky, and Bragi Valgeirsson. 1990. "Demographic and Economic Trends." Journal of Housing Research 1, no. 1: 21-42.

Armknecht, Paul A., Brent R. Moulton, and Kenneth J. Stewart. 1995. "Improvements to the Food at Home, Shelter, and Prescription Drug Indexes in the U.S. Consumer Price Index." Bureau of Labor Statistics Working Paper no. 263.

Bryan, Michael F., and Stephen G. Cecchetti. 1994. "Measuring Core Inflation." In N. Gregory Mankiw, ed., Monetary Policy. NBER Studies in Business Cycles, Vol. 29, 195-215. Chicago: University of Chicago Press.

Bryan, Michael F., Stephen G. Cecchetti, and Rodney L. Wiggins II. 1997. "Efficient Inflation Estimation." NBER Working Paper no. 7479.

Crone, Theodore M., Leonard I. Nakamura, and Richard Voith. 2001. "Measuring American Rents: A Revisionist History." Federal Reserve Bank of Philadelphia Working Paper no. 01-8.

DiPasquale, Denise, and William C. Wheaton. 1994. "Housing Market Dynamics and the Future of Housing Prices." Journal of Urban Economics 35, no. 1 (January): 1-27.

Dougherty, Ann, and Robert Van Order. 1982. "Inflation, Housing Costs, and the Consumer Price Index." American Economic Review 72, no. 1 (March): 154-64.

Epstein, Gene. 2000. "Inflation's Upward Creep Would Look Even Worse if BLS Counted What's Really Happening to Housing." Barron's, March 20, p. 40.

Gillingham, Robert. 1983. "Measuring the Cost of Shelter for Homeowners: Theoretical and Empirical Considerations." Review of Economics and Statistics 65, no. 2 (May): 254-65.

Mankiw, N. Gregory, and David N. Weil. 1989. "The Baby Boom, the Baby Bust, and the Housing Market." Regional Science and Urban Economics 19, no. 2 (May): 235-58.

Moulton, Brent R. 1997. "Issues in Measuring Price Changes for Rent of Shelter." Paper presented at the conference "Service Sector Productivity and the Productivity Paradox." Ottawa: Centre for the Study of Living Standards.

Ptacek, Frank, and Robert M. Baskin. 1996. "Revision of the CPI Housing Sample and Estimators." Monthly Labor Review 119, no. 12 (December): 31-9.

U.S. Census Bureau. 1999. "Current Construction Reports— Characteristics of New Housing: 1998, C25/98-A." Washington, D.C.: U.S. Department of Commerce.

———. 2000. "Current Construction Reports—Housing Completions: December 1999, C22/99-12." Washington, D.C.: U.S. Department of Commerce.

U.S. Department of Labor. 1996. "How the Consumer Price Index Measures Homeowners' Costs." Fact Sheet no. BLS 96-6. Washington, D.C.: Bureau of Labor Statistics.

———. 1999. "Consumer Price Indexes for Rent and Rental Equivalence." Fact Sheet no. BLS 99-4. Washington, D.C.: Bureau of Labor Statistics.

ENDNOTES

[1] The weights of OER and tenant rent are based on the Consumer Expenditure Survey. To determine the weight for OER, the survey asks homeowners to estimate what their homes would rent for, excluding utilities and the value of furnishings.

[2] Shelter is an important component in alternative measures of core inflation as well. For the median CPI, Bryan and Cecchetti (1994) show that shelter is at the median in about 48 percent of their sample, which is well above its weight in the CPI measure, shelter is trimmed in less than 13 percent of the time within their sample period, which is below its weight in the CPI.

[3] "Here's the scandal: The BLS would have us believe that inflation in this all-important sector has actually slowed over the past year, even though all real world evidence tells us it could only have accelerated" (Epstein 2000).

[4] The role of energy prices is discussed below.

[5] This section draws heavily on several BLS publications, including U.S. Department of Labor (1996, 1999) and Ptacek and Baskin (1996).

[6] These characteristics include the number of bedrooms, bathrooms and other rooms in the unit; utilities and facilities provided; and the type of energy used for heating and cooling.

[7] Theoretically, another option in measuring the implicit rent of owner-occupied housing is to calculate its user cost (for example, see Dougherty and Van Order [1982]). At the time that the BLS adopted the rental equivalence approach, it suggested that this approach could measure user cost more efficiently (see Gillingham [1983]).

[8] The BLS changed the formula that is used to compute the percentage change of OER (the Sauerbeck formula) to eliminate "chain drift." In addition, the BLS began basing changes in OER (and in tenant rent) on six-month rent changes only. Previously, the changes in OER were based on a weighted average of one-month and six-month rent changes. BLS research revealed that this tended to understate rent changes because tenants moving into a housing unit frequently do not know the rent paid by the previous tenant in the previous month. For further details, see Armknecht, Moulton, and Stewart (1995).

[9] "Research performed by the BLS using 1980 and 1990 census data indicates that geographic location is the most important variable…in determining rent change. Once geography is taken into account, only rent level is significant in predicting rent change" (Ptacek and Baskin 1996).

[10] Even though we use the same definition of the rental vacancy rate as the CPS/Housing Vacancy Survey, the vacancy rate computed from the AHS is lower that that derived from the Housing Vacancy Survey; in 2001, this difference was about 0.5 percentage point. The Census Bureau is aware of this discrepancy, but it is not certain of its cause.

[11] Data on the number of households come from the U.S. Census Bureau, Current Population Reports, "Household and Family Characteristics," Series P20. The data for households in 2001 reflect the 2000 census, which inflates this number relative to previous years.

[12] This homeownership rate is comparable to the rate from the CPS/Rental Vacancy Survey. According to that survey, the homeownership rate was 68 percent in the third quarter of 2002.

[13] The variable also includes, in a small number of cases, the cost of renter's insurance.

[14] We included the squared value of the log level of housing costs as an explanatory variable to test for nonlinearity, but it was statistically insignificant with a negative sign.

[15] Crone, Nakamura, and Voith (2001) also develop an alternative tenant rent series using AHS data that suggests a higher rate of tenant rent inflation than is reported in the CPI. Although the period of their study mostly precedes ours, the first three panels of our study overlap with theirs.

[16] The density functions presented in Chart 6 are smoothed versions of the empirical distribution, using an Epanechnikov kernel with a bandwidth parameter of 100 for renters and 300 for owners.

[17] After 1995 the AHS did not collect housing cost information for vacant housing units.

Table 1

Housing in the CPI[1]

	Relative Importance	
	Total CPI	Core CPI
Consumer Price Index	100.0%	100.0%
Housing	39.56	-
Shelter	29.79	38.36
Rent of primary residence	6.89	8.87
Lodging away from home	2.33	3.00
Owners' equivalent rent of primary residence	20.20	26.01
Tenants' and household insurance	0.38	0.49
Fuels and utilities	4.94	-
Household furnishings and operations	4.83	-

Source: Bureau of Labor Statistics

1. The CPI-U, or CPI for all urban consumers over the period from January 1998 through December 2001. New weights were introduced beginning with the January 2002 CPI data.

Chart 1

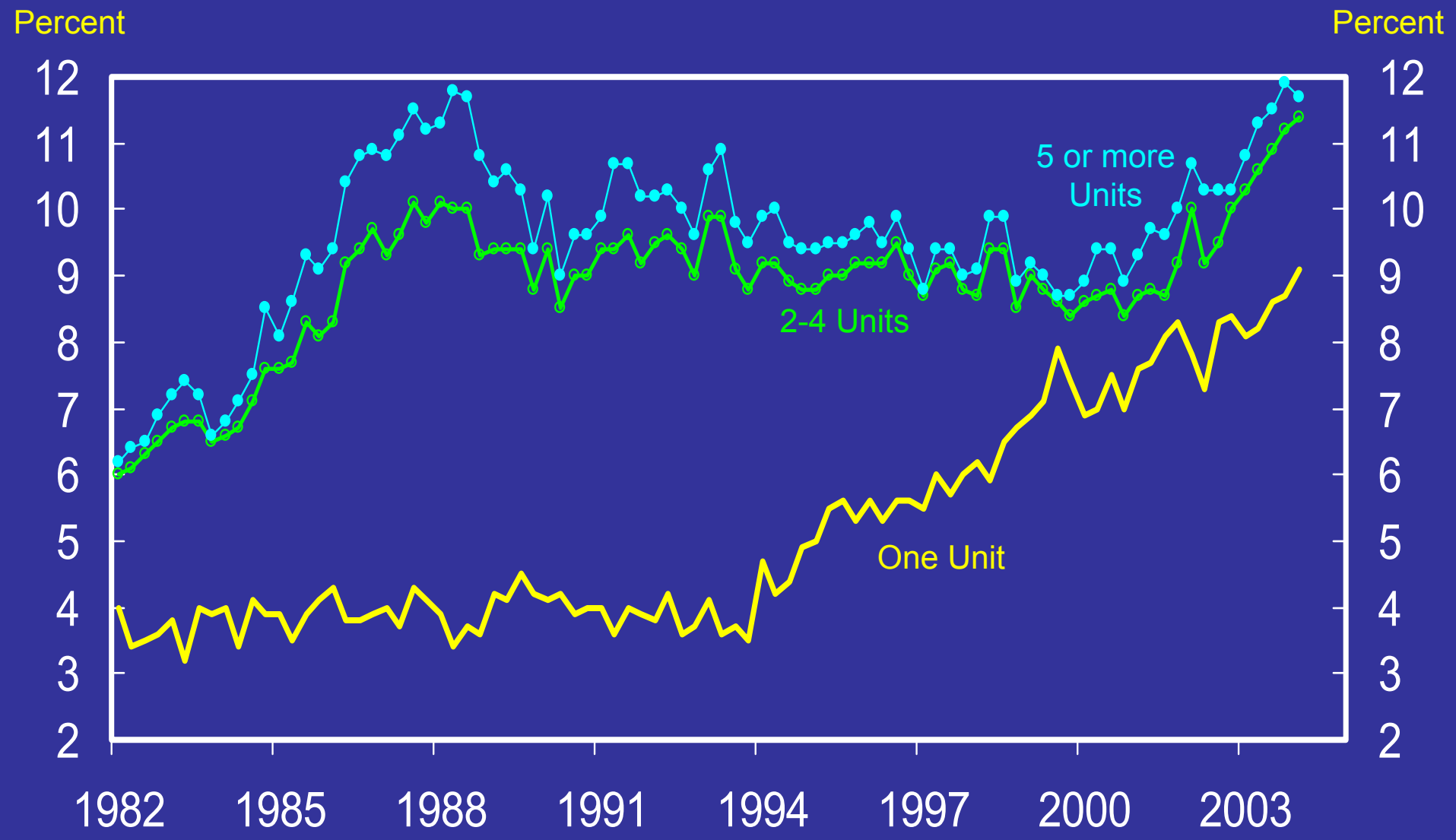
Housing Turnover and Price Appreciation

Notes: The turnover rate is the ratio of existing home sales to the stock of single family homes. Home price appreciation calculated from the repeat sales index produced by the Office of Federal Housing Enterprise Oversight. Sources: Bureau of the Census, National Association of Realtors, Office of Federal Housing Enterprise Oversight.

Chart 2

Rental Vacancy Rates

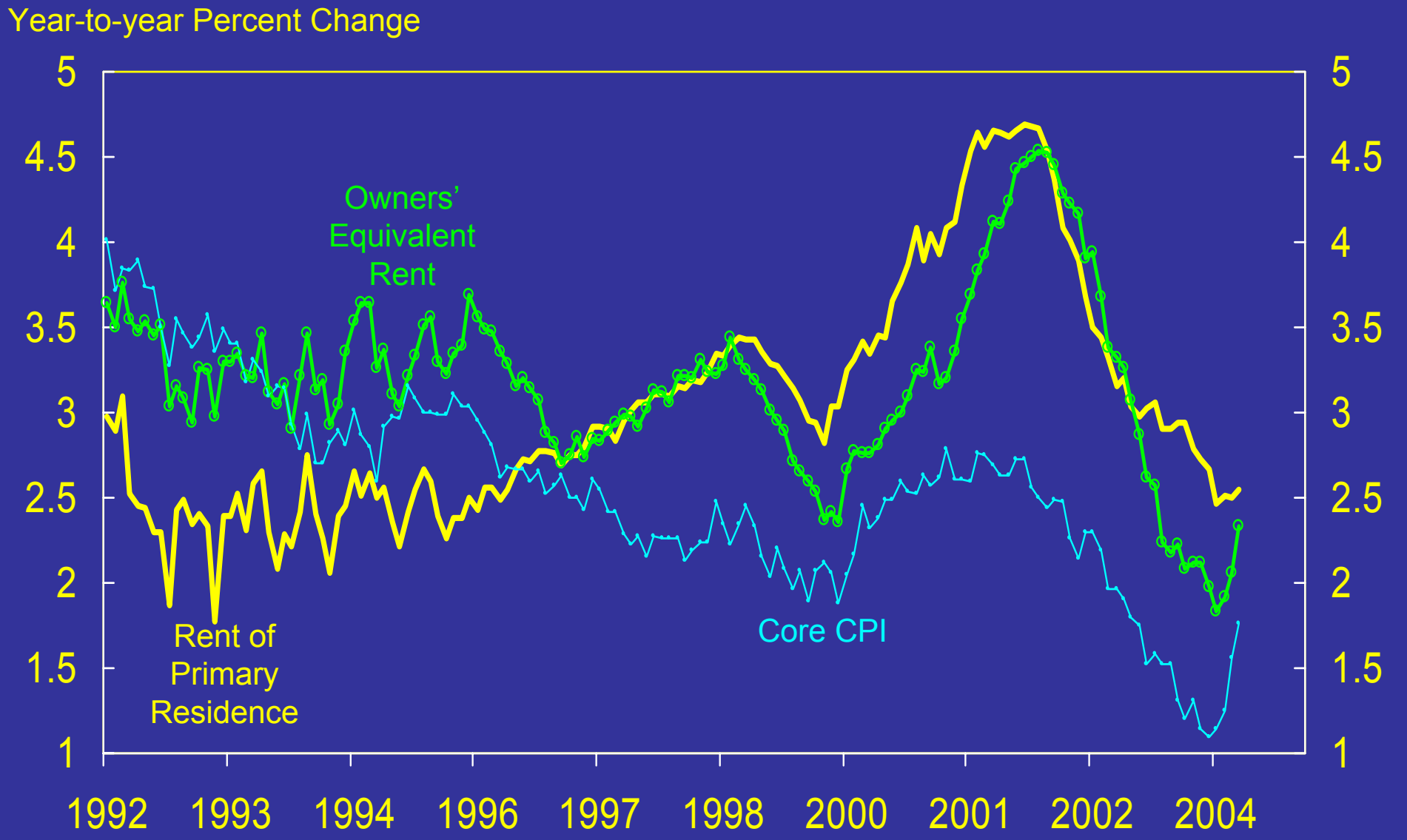
(Not Seasonally Adjusted)



Source: Department of Commerce

Chart 3

Rent Inflation in the CPI



Source: Bureau of Labor Statistics.

Table 2

Distribution of Housing Stock: 2001

(Percent of Total Stock)

	1 Unit	2-4 Units	5+ Units	Mobile	Total
Vacant	4.52	0.89	2.08	0.84	8.3
For Rent or For Rent or Sale	0.71	0.46	1.20	0.12	2.5
For Sale Only	0.80	0.05	0.08	0.14	1.1
Rented/Sold but not yet Occupied	0.40	0.05	0.15	0.07	0.6
Occasional Use/URE* & Other	2.63	0.33	0.67	0.51	4.1
Occupied	64.21	7.00	14.21	6.25	91.7
Owner	54.31	1.10	1.74	5.19	62.3
Renter	9.91	5.89	12.49	1.06	29.3
Total	68.7	7.9	16.3	7.1	100.0
Rental Vacancy Rate	6.6	7.2	8.7	10.5	7.8
Rented or For Rent	15.6	81.1	84.6	16.7	32.0

* Usual Residence Elsewhere.

Source: American Housing Survey

Table 3

Growth of the Housing Stock: 1993-2001

(Annualized Growth Rates)

	1 Unit	2-4 Units	5+ Units	Mobile	Total
Vacant	2.99	-3.18	-0.73	3.26	1.19
For Rent Only or For Rent or for Sale	4.41	-2.27	0.59	3.74	1.06
For Sale Only	4.99	-0.50	3.18	14.85	4.15
Rented or Sold but not yet Occupied	-0.16	-8.30	-5.19	7.39	-1.97
Occasional Use/URE* & Other	2.95	-3.67	-2.04	1.51	1.17
Occupied	1.87	-1.65	0.78	3.16	1.46
Owner	2.12	-5.25	2.30	5.06	2.11
Renter	0.58	-1.16	0.78	0.56	0.21
Total	1.94	-1.83	0.58	3.17	1.44

* Usual Residence Elsewhere.

Source: American Housing Survey

Table 4

Coefficients from Rent-Change Regression

	Log of Housing Cost	Multi-family Building Dummy	Midwest Dummy	South Dummy	West Dummy	Suburban Dummy	Rural Dummy	Change in Square Feet	Change in Neighborhood Rating*	Constant	R^2	Root Mean Square Error
Coef.	-2.17	0.66	0.49	0.38	1.02	-0.034	-1.06	0.0015	0.079	16.93	0.014	9.74
Std. Error	0.18	0.15	0.24	0.22	0.22	0.148	0.22	0.0013	0.060	1.14		
t-stat.	-12.2	4.4	2.04	1.74	4.7	-0.23	-4.81	1.17	1.31	14.81		

Panel Fixed Effects

	1991-1993	1993-1995	1995-1997	1997-1999	1999-2001
Coef.	-0.55	-0.68	-1.83	-1.34	1.34
Std. Error	0.17	0.18	0.45	2.21	1.41
t-stat.	-3.17	-3.9	-4.08	-0.61	0.95

*Positive numbers represent improvements in neighborhood rating.

Table 5

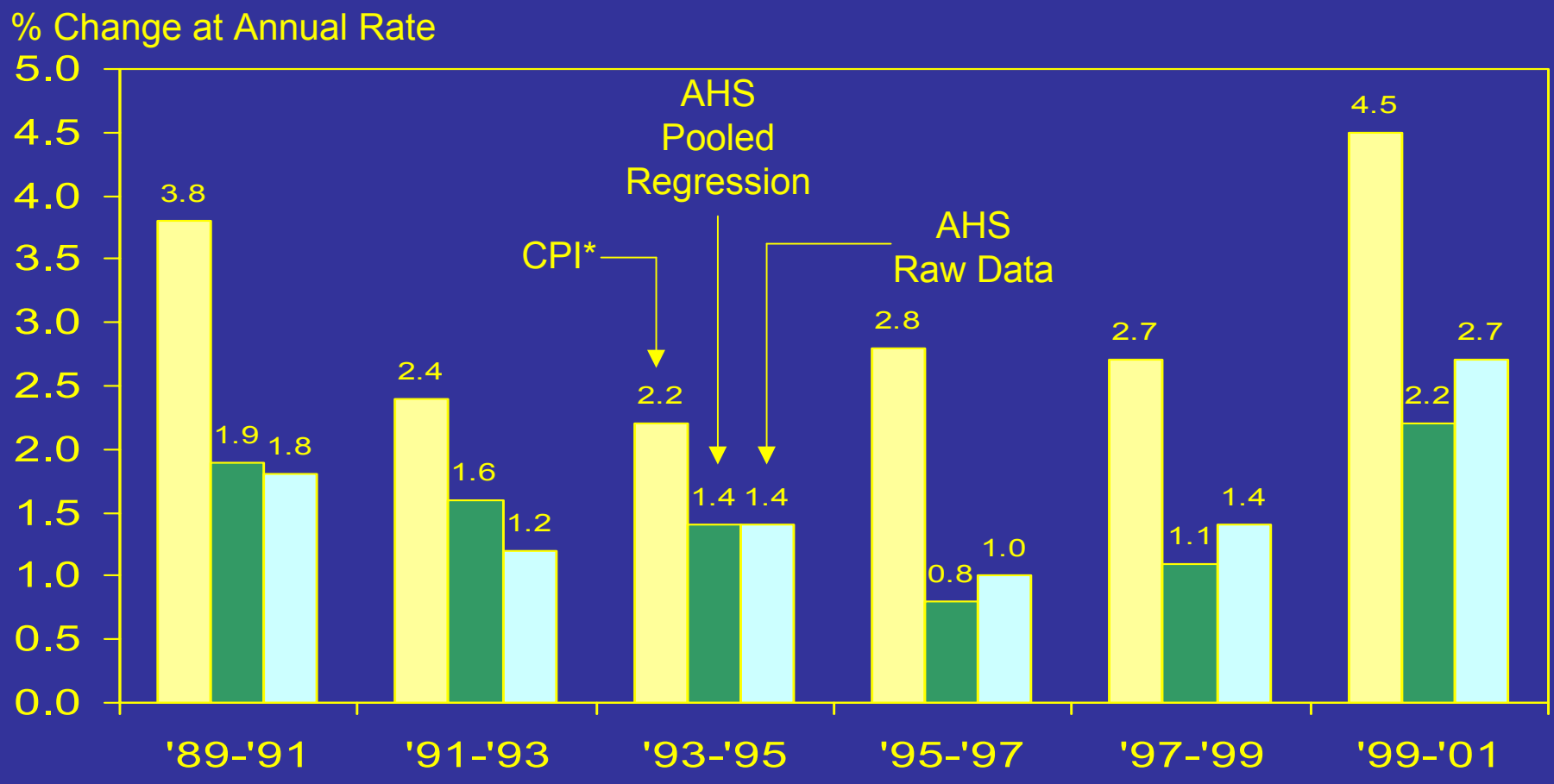
Construction of CPI Measure of Tenant Rent + Utilities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	CPI Data		AHS Data				
	(Annualized Change)		Average Utility Expenditure as a percent of Housing Cost	Weighted Average of percent of units paying for utils separate from rent	Average of column (4) over two year intervals	Average of column (5) over two year intervals	CPI for Rent + Utilities *
	Tenant Rent	Utlities					
1989			16.4%	70.9%			
1991	3.9%	3.4%	15.5%	71.4%	16.0%	71.1%	3.8%
1993	2.4%	2.6%	16.5%	73.1%	16.0%	72.2%	2.4%
1995	2.4%	0.9%	16.5%	74.7%	16.5%	73.9%	2.3%
1997	2.8%	2.8%	14.0%	64.2%	15.3%	69.4%	2.8%
1999	3.2%	-0.7%	13.2%	64.2%	13.6%	64.2%	2.9%
2001	4.0%	8.0%	13.5%	65.6%	13.3%	64.9%	4.4%

* Formula: (col. 4) x {[(1 - col. 3) x (col. 1)] + [(col. 3) x (col. 2)]} + [(1-col. 4) x (col. 1)]

Chart 4

Tenant Rent Inflation: AHS and CPI Measures



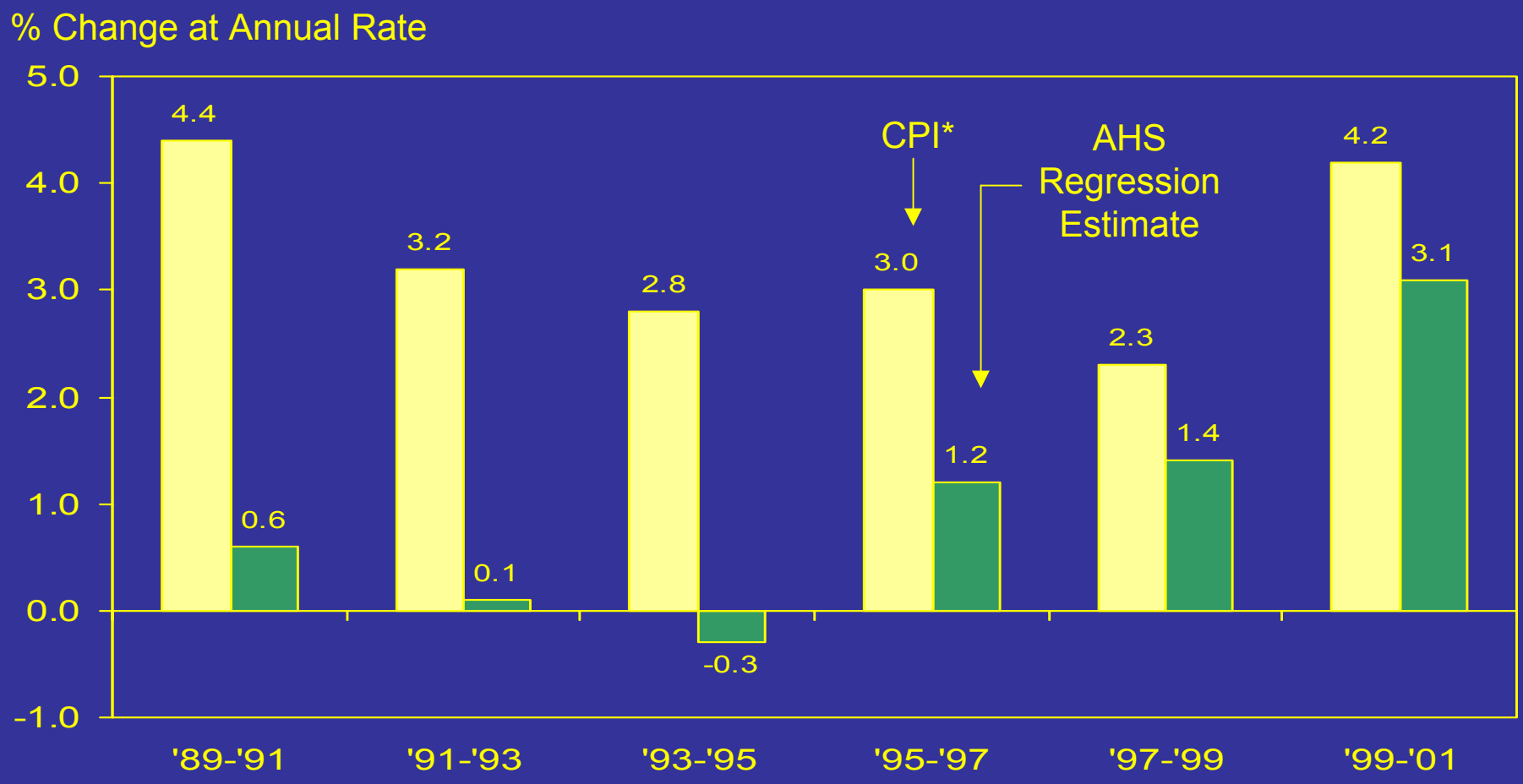
* Weighted average of the increase in rent of primary residence and in utilities. Weights based on AHS data

Note: All AHS calculations made with 25% trimming.

Sources: Bureau of Labor Statistics, American Housing Survey, and authors' calculations.

Chart 5

OER Inflation: AHS and CPI Measures



* Weighted average of the increase in OER and in utilities. Weights based on AHS data

Sources: Bureau of Labor Statistics, American Housing Survey, and authors' calculations.

Table 6

Growth of Rent by Rent Quintile*

(annualized growth rates)

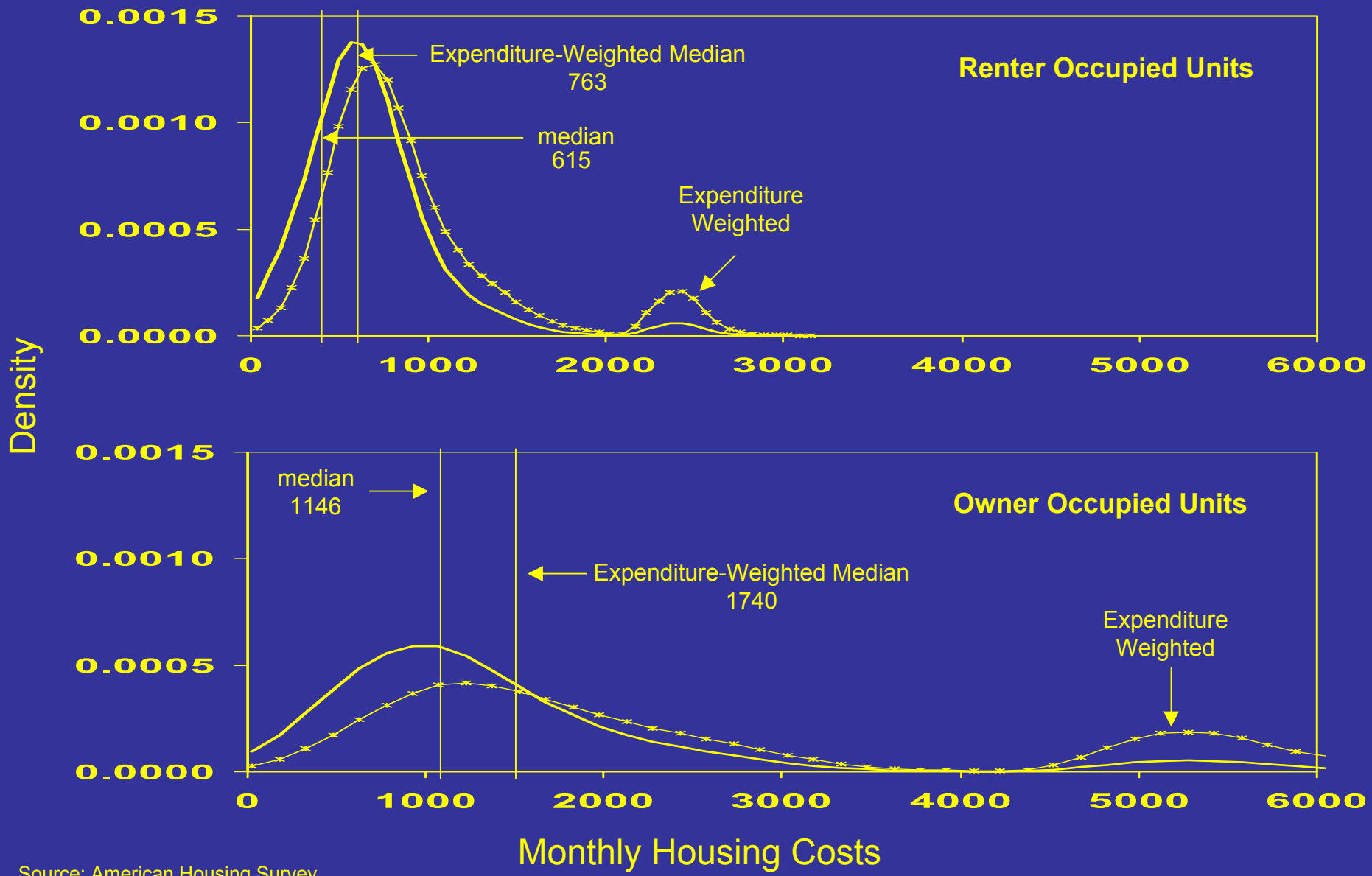
Period	Lowest 5th	4th	3rd	2nd	Highest 1st	Top 10%	Top 5%
1999-2001	4.5	4.1	3.2	2.7	2.5	2.3	2.4
1997-99	3.3	2.7	2.2	1.7	0.7	0.6	0.2
1995-97	2.8	2.3	1.5	0.9	0.4	0.6	0.9
1993-95	4.1	3.1	2.5	1.5	0.9	1.0	1.1
1991-93	4.2	3.2	2.9	1.6	0.4	-0.2	-0.5
1989-91	4.5	4.0	3.1	2.1	1.3	1.3	1.2

* Occupied rental units ranked by monthly housing cost.

Source: American Housing Survey.

Chart 6

Distribution of Units by Monthly Housing Cost: 2001*



Source: American Housing Survey

* Empirical distributions smoothed using an Epanechnikov kernel with a bandwidth parameter of 100 for renters and 300 for owners.

Table 7

Average Pretax Family Income
(in 2000 Dollars)

	1989	2001	Percent Change, Annual Rate 1989-2001
Lowest Quintile	8,125	7,440	-0.7
Second Quintile	20,905	22,703	0.7
Middle Quintile	34,145	38,070	0.9
Fourth Quintile	52,020	61,690	1.4
Highest Quintile	102,541	169,765	4.3
All Families	43,300	59,348	2.7
Top 10 percent	124,653	231,829	5.3
Top 5 percent	148,677	322,445	6.7
Top 1 percent	192,068	464,524	7.6

Notes: Quintiles are based on family income. Nominal income quantities have been deflated to 2000 dollars using the PCE deflator.

Source: American Housing Survey, Bureau of Economic Analysis

Table 8

Vacancy Rate by Housing Cost Quintile*

Period	Lowest 5th	4th	3rd	2nd	Highest 1st	Top 10%	Top 5%
1995	13.9	5.9	6.1	3.5	3.8	3.7	0.0
1993	10.9	7.1	3.9	4.0	3.3	2.8	0.0
1991	12.8	7.1	5.8	4.2	4.5	5.2	0.0
1989	11.2	7.6	5.0	2.6	3.7	4.5	0.0

* Rental units ranked by monthly housing cost. After 1995, the AHS did not report monthly housing cost for vacant units.

Source: American Housing Survey.

Table 9

Distribution of housing units in 1989 and 2001 based on 1989 income quintiles

(percent except where noted)

	Total		Renter-occupied		Owner-occupied	
1989 income quintile	1989	2001	1989	2001	1989	2001
1	20.0	20.4	29.6	31.3	14.6	15.7
2	20.0	17.7	26.4	25.1	16.4	14.5
3	20.0	17.5	21.7	20.8	19.0	16.0
4	20.0	17.9	15.1	13.4	22.7	19.9
5	20.0	26.4	7.1	9.4	27.2	33.9
Memo: number of units (millions)	84.6	107.1	30.3	32.8	54.2	74.3

Table 10

Housing unit dynamics by income quintiles

(million of units)

(a) Total

1989 income quintile	change in units 1989-2001	change due to: net filtering	new construction	net conversions	within quintile switches
1	5.0	1.8	2.3	0.9	0.0
2	2.1	-0.3	2.2	0.1	0.0
3	1.8	-1.3	2.7	0.4	0.0
4	2.3	-2.1	3.4	1.0	0.0
5	11.4	1.9	6.6	2.9	0.0

(b) Renter-occupied

1989 income quintile	change in units 1989-2001	change due to: net filtering	new construction	net conversions	within quintile switches
1	1.3	0.2	0.8	0.0	0.3
2	0.2	-0.4	0.7	-0.3	0.2
3	0.2	-0.5	0.7	-0.1	0.1
4	-0.2	-0.3	0.5	-0.1	-0.3
5	0.9	1.0	0.4	0.1	-0.7

(c) Owner-occupied

1989 income quintile	change in units 1989-2001	change due to: net filtering	new construction	net conversions	within quintile switches
1	3.7	1.6	1.5	0.9	-0.3
2	1.9	0.2	1.5	0.4	-0.2
3	1.6	-0.9	2.0	0.5	-0.1
4	2.5	-1.8	2.9	1.1	0.3
5	10.4	0.9	6.1	2.7	0.7

Table For Box

Example of Rent Inflation Measurement

Segment	1	2	3
Type	1	1	2
Number of units			
renters	100	100	150
owners	150	150	100
(a) Similar renter and owner units			
Rents in period 1 (dollars)			
renters	400	400	200
owners	400	400	200
Rent change between periods (percent)			
renters	4	4	2
owners	4	4	2
Aggregate rent change (percent)	Actual	CPI	
renters	3.14	3.14	
owners	3.5	3.5	
(b) Rent changes differ between renter and owner units in one segment.			
Rents in period 1 (dollars)			
renters	400	400	200
owners	400	400	200
Rent change between periods (percent)			
renters	4	2	2
owners	4	4	2
Aggregate rent change (percent)	Actual	CPI	
renters	2.57	2.57	
owners	3.5	2.75	