

## The Rent-Price Ratio for the Aggregate Stock of Owner-Occupied Housing<sup>1</sup>

Morris A. Davis, Andreas Lehnert, and Robert F. Martin

Federal Reserve Board, May, 2005

*Abstract* We construct a time series of the rent-price ratio for the owner-occupied stock of housing, starting in 1960:1, by merging micro data from the last five Decennial Censuses of Housing with price indexes for house prices and rents.

*Keywords:* House Prices, Housing, Rents, CMHPI, Capitalization Rates

*JEL Codes:* E01, G12, R0, R21, R31

This paper develops a quarterly time-series, starting in 1960:1, of the ratio of imputed rents of homeowners to the average value of owner-occupied housing – the “rent-price ratio” – for the stock of owner-occupied housing.

Little work has been done to estimate a continuous time series of the *level* of the rent-price ratio for the aggregate stock.<sup>2</sup> The rent-price ratio is the equivalent for residential housing of the earnings-price ratio for stocks, and is thus an important component of housing valuations. The level of the rent-price ratio can be informally compared to some cost of capital, or formally used in asset pricing models, as in Davis and Martin (2004), who show that the Euler equation for pricing housing can be written:  $1 = (rent/price)_t + E_t[m_{t+1}(p_{t+1}/p_t)]$ .

We use micro data from the last five Decennial Censuses of Housing (DCH) to develop benchmark estimates of aggregate average imputed rents to homeowners, average prices of owned homes, and the aggregate rent-price ratio for the owner-occupied stock. We use quarterly rent- and house price- indexes to interpolate rents and prices, respectively, between DCH benchmarks as well as extrapolate past the 2000 DCH.

**Benchmark DCH Estimates** In each DCH from 1960-2000, a 1 percent sample of household-level data is available on rents paid by renters and the market value of housing units for homeowners.<sup>3</sup> For each DCH, we regress log gross rents of renters (contract rent plus costs for utilities) on a set of hedonics. We then predict gross rents for each owner-occupied property and subtract reported utilities costs to compute net rent. Our estimates of gross rents, utilities expenses, net rents, average prices, and the resulting rent-price ratios (annual rate) are shown in columns (1) through (6) of table 1.<sup>4</sup>

---

<sup>1</sup>For comments and suggestions, we would like to thank Josh Gallin, Michael Palumbo and Steve Oliner. The views in this paper are solely the responsibility of the authors and do not necessarily reflect the views of the Board of Governors of the Federal Reserve System or its staff. Contact author: Morris A. Davis, 20th and C St. NW, stop 97, Washington, DC 20551, phone: 202 452-3628, fax: 202 728-5889, email: [morris.a.davis@frb.gov](mailto:morris.a.davis@frb.gov)

<sup>2</sup>In previous studies such as Meese and Wallace (1994) and Cutts, Green, and Chang (2005), authors have derived a rent-price ratio for specific metro areas at one or two points in time. Gallin (2004) constructs a quarterly *index* of the rent-price ratio; this index tracks movements in the growth rate of prices relative to rents. Crone, Nakamura, and Voith (2004) use American Housing Survey data to derive a biennial estimate of the aggregate rent-price ratio from 1985-1999.

<sup>3</sup>These data are available at the Integrated Public Use Microdata Series (“IPUMS”) web site, <http://www.ipums.org/usa/>.

<sup>4</sup>For more details on these calculations, see the appendix, available at <http://morris.marginalq.com>.

**Interpolating Rents** We use the quarterly CPI tenant rent index to interpolate average net rent between DCH benchmarks and to extrapolate beyond 2000. The first column of the top-half of table 2 reports average annual growth in average net rents from the DCH, the middle column shows average annual growth in the tenant rent index, and the last column reports the percentage point difference between the two.<sup>5</sup> To interpolate net rents between DCH observations, we adjust the observed quarterly changes in the CPI tenant rent index so that the series passes through the DCH benchmark levels. To extrapolate beyond 2000, we use the same procedure and assume that improvements in quality are the same as from 1990 through 2000.

**Interpolating House Prices** We use the repeat-sales house price index published by Freddie Mac (CMHPI) to interpolate average house prices quarterly between Census years and to extrapolate beyond 2000.<sup>6</sup> Because the CMHPI is not available before 1970, from 1960 to 1970 we interpolate using the median price of new homes sold.<sup>7</sup> The bottom half of table 2 reports changes in average house prices as measured in the DCH and by the CMHPI, and their difference. As with rents, we adjust quarterly changes in the CMHPI so that the series passes through the DCH benchmark prices.

**Results** Figure 1 graphs our estimate of the annual rent-price ratio.<sup>8</sup> The rent-price ratio modestly declined between 1960 and 2000, and then fell sharply from 4.6 percent to 3.9 percent at the end of 2004. By the Euler equation for housing, this drop requires that  $E_t[m_{t+1}(p_{t+1}/p_t)]$  has increased by around 1 percentage point. Without an estimate of the level, we could have inferred nothing about the change in expected capital gains; we would only have known that prices grew 18 percent faster than rents since 2000.

## References

- Crone, T. M., L. I. Nakamura, and R. Voith (2004). Hedonic estimates of the cost of housing services: rental and owner-occupied units. Working Paper 04-22, Federal Reserve Bank of Philadelphia.
- Cutts, A., R. Green, and T. Chang (2005). Did changing rents explain changing house prices during the 1990s? mimeo.
- Davis, M. and R. F. Martin (2004). Housing, house prices, and the equity premium puzzle. Finance and Economics Discussion Series 2005-13, Federal Reserve Board.
- Gallin, J. (2004). The long-run relationship between house prices and rents. Finance and Economics Discussion Series 2004-50, Federal Reserve Board.
- Lebow, D. and J. Rudd (2003). Measurement error in the consumer price index: Where do we stand? *Journal of Economic Literature* 41(1), 159–201.
- Meese, R. and N. Wallace (1994). Testing the present value relation for housing prices: Should i leave my house in San Francisco? *Journal of Urban Economics* 35(3), 245–66.

---

<sup>5</sup>Because the CPI rent index captures changes in constant-quality rents, in principle, the last column reflects growth in the average quality of housing units as well as any bias in the CPI (Lebow and Rudd 2003).

<sup>6</sup>We smooth the CMHPI as in Davis and Heathcote (2004).

<sup>7</sup>This data source begins in 1963:1. To extend the estimates back to 1960, we assume that median new house prices grew at a constant rate from 1960 to 1963, such that total growth of our interpolated price series from 1960 to 1970 equals total growth of average home prices according to the 1960 and 1970 DCH.

<sup>8</sup>These data are available at <http://morris.marginalq.com>.

**Table 1: Measures of Housing Valuation from the Decennial Census of Housing**

DCH	Average monthly gross rents	Average monthly utilities expenses	Average monthly net rents	Average annual net rents	Average Price	Annual rent-price ratio (percent)
	(1)	(2)	(3) = (1) - (2)	(4) = 12*(3)	(5)	(6) = (4)/(5)
1960	\$90	\$22*	\$68	\$816	\$14,566	5.6%
1970**	\$133	\$32	\$101	\$1,212	\$20,867	5.8%
1980	\$341	\$101	\$240	\$2,880	\$59,059	4.9%
1990	\$620	\$149	\$471	\$5,652	\$117,693	4.8%
2000	\$826	\$184	\$642	\$7,704	\$165,556	4.6%

\* This is an assumed value. \*\* Single-family units only. All dollar values are nominal. See data appendix for more details.

**Table 2: BLS Tenant Rent Index and CMHPI vs. DCH Benchmarks**

Years	Net rents, DCH Annual percent change	CPI tenant-rent index* Annual percent change	Difference, Percentage Points
1960 - 1970	4.0	1.8	2.2
1970 - 1980	9.0	5.7	3.4
1980 - 1990	7.0	5.5	1.5
1990 - 2000	3.1	2.9	0.3

  

Years	Average prices, DCH Annual Percent Change	CMHPI** Annual Percent Change	Difference, Percentage Points
1960 - 1970	3.7	NA	NA
1970 - 1980	11.0	8.2	2.8
1980 - 1990	7.1	5.1	2.0
1990 - 2000	3.5	3.7	-0.3

\* Decade-to-decade growth is calculated from month 6 of year  $t$  through month 6 of year  $t+10$ .

\*\* Decade-to-decade growth is calculated from Q2 of year  $t$  through Q2 of year  $t+10$ . The CMHPI is available starting in 1970:1.

**Figure 1**

