The Price of Housing in the United States, 1890–2006*

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Abstract

We construct the first consistent market rent and home sales price series for American cities across the 20th century using millions of newspaper real estate listings. Our findings revise several stylized facts about U.S. housing markets. Real market rents did not fall during the 20th century for most cities. Instead, real rental price levels increased by about 20% from 1890 to 2006. There was also greater growth in real housing sales prices from 1965 to 1995 than is commonly understood. Using these series we document several new facts about housing markets. The return to homeownership has varied considerably across cities and over time, but rental returns were historically much more important than capital gains in every city. We discuss the implications of our indices for the business cycle and the consumer price index. Finally, we provide evidence that housing prices increased unevenly across cities over time in response to natural building and regulatory constraints.

Keywords: Housing prices; rental indices; hedonic analysis; housing markets.

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1 Introduction

Housing is central to economics. It is both a key service and an important asset in the United States, with housing the largest single component of consumer expenditure and household balance sheets. Despite the centrality of housing to the American economy, existing long-run housing price series are very limited, particularly prior to the 1970s for housing sales and for any period of the 20th century for market rents. Scholars interested in rental prices have used the Bureau of Labor Statistics (BLS) Rent of Primary Residence (RoPR) series, which is based on contract rents and used to construct consumer price indices. Scholars interested in sales prices have primarily relied on the pioneering work of Robert Shiller, who spliced together several data sources to obtain a national housing sales price series beginning in 1890 (Shiller, 2015). Together, the RoPR and Shiller series underlie important recent work studying the national housing market (Jordà et al., 2019; Knoll et al., 2017).

On the other hand, annual city-level housing price series that span the 20th century do not exist in the U.S., for either market rents or sales.[1] The first annual, quality-adjusted price series for market rents in U.S. cities begin after 2000 (Ambrose et al., 2015). Annual city-level housing price series are not available until 1975, when the Federal Housing Finance Agency (FHFA) indices begin. Economists thus know relatively little about how the market price of rented and owned housing has evolved within and across U.S. cities over the long run. As a consequence, we cannot measure the long-run return to owning housing – either the rental yield or capital gain – across American cities over the 20th century. It has also been impossible to ask how market rents or market rent-to-price ratios have historically evolved with the business cycle, and scholars have been limited in their ability to systematically investigate how or why housing prices have increased in some cities more than others. These questions are fundamental to our understanding of housing markets and the U.S. economy more broadly.

[1] Much of the work on U.S. housing markets relies on the decadal census, which started asking about home values and rents in 1930.

This paper introduces a dataset from the Historical Housing Prices (HHP) Project that provides new price series for both rents and sales constructed from archival newspaper real estate sections. These series draw on over 2.7 million listings from 30 cities over the 1890-2006 period that include a price as well as measures of size, type and location within the city. Using hedonic methods, we construct new housing price indices for both the rented and owned segments for cities across the U.S. We aggregate using population weights to construct national indices. These series are unique because they are constructed consistently across the period and reflect market conditions in each city at an annual frequency. In contrast to many other datasets on housing sales or rental prices, the HHP series are based on publicly available sources and can be freely distributed.[2]

The first part of this paper compares the HHP series to existing sources of information on U.S. housing prices. Beginning with market rents, we find substantially more volatility in market rental price levels compared with the BLS Rent of Primary Residence (RoPR) series, which smooths market fluctuations by design and which historically incorporated new construction with substantial lags. In addition, and in contrast to the RoPR series, we find no evidence that real rents fell during the 20th century in most cities. Rather, national rental prices were about 20% higher in 2006 relative to 1890, fluctuating within a relatively narrow band over the century. Our national series substantially agrees with adjustments to the RoPR series proposed by Gordon & van Goethem (2007) and Crone et al. (2010) that have been adopted by economists in recent work on national U.S. housing prices levels (Knoll et al., 2017).

For sales prices, the HHP series aligns well with the Case-Shiller-Weiss and FHFA repeat-sales series at both the national and city level after 1990 despite the differences in methodology. However, the series diverge substantially in earlier decades precisely where historians of housing markets have noted limitations of the data sources underlying the Shiller index, particularly the reliance on a single retrospective survey for the 1890-1934 period (Fishback & Kollmann, 2014) and on truncated loan data for the 1953-1975 period

[2]The HHP indices are available at https://www.philadelphiafed.org/surveys-and-data/regional-economic-analysis/historical-housing-prices.

(Greenlees, 1982). We find evidence of a sizable interwar housing cycle that is not present in the Shiller series, with housing prices rising by two-thirds from 1920 to 1928 and then falling by more than a quarter from 1928 to 1935. In addition, we find that U.S. housing prices began increasing in real terms by the late 1960s, similar to census trends and in contrast to the Shiller index, which reports relatively little housing price growth from 1950 to 1995 (Davis & Heathcote, 2007; Davis et al., 2007).

The second part of the paper uses the HHP data to document several new facts about housing markets across the 20th century United States. We show, for the first time, how market rents and housing prices have evolved on an annual basis with the business cycle. We find that both price series are strongly linked with GDP, moving together in most years. Some recessions saw sales prices and rents fall shortly after the downturn began, as happened after the 1896 and 1980 downturns, while in other cases rents fell before GDP, most notably in the Great Depression and again in the early 1990s recession. In addition, after both World War I and World War II we document economic contractions accompanied by surging housing prices. Finally, we show that, starting in the 1970s, rents keep their relatively flat trend while housing prices take off, consistent with previous work (Gyourko et al., 2013).

Second, we produce, for the first time, annual series reporting the rent-to-price ratio, rental return, capital gain, and total return to owning housing at both the national and city level for the full 1890-2006 period. We find gross market rental yields were at least 8% annually for much of the 1900-1945 period but fell during the 1920s boom and rose during the Great Depression. Yields then fell to 7% by 1960 and to 3% by 2006. Capital gains were largely unimportant until the 1940s, after which they averaged 6% annually in nominal terms for the rest of the 20th century. In aggregate, the average annual nominal housing return across the 1890-2006 period was 11.3%, with 3.7% as capital gain and 7.5% as rental return. Over the long run, the return to housing has been dominated by the rental income component. The post-1980 period, with its high and sustained capital gains, is somewhat of an anomaly from a historical perspective.

The corresponding city-level series shed light on many debates on the performance of housing as an asset, particularly the apparent lack of volatility of housing returns as discussed in Jordà et al. (2019). We argue that part of the solution to this puzzle is the aggregation of local housing markets with different trajectories to create national indices. We find strikingly different returns of housing across time and space, with some cities seeing returns exceeding that of the S&P 500, particularly in the prewar era, while housing underperformed equities in the 1981-2006 period in most cities. However, the best-performing housing markets varied over time, with Minneapolis and Louisville providing some of the highest returns before the Great Depression and Portland and Phoenix among the highest after World War II.

Third, we use our market rents series to revisit a puzzle from the literature on costs of living. The CPI excluding shelter generally increased by about 3.3% a year from 1914 to 2006. However, the Rent of Primary Residence component of the Bureau of Labor Statistics CPI grew by only about 2.6% a year. Why did rents rise by less than other prices over the past century? The HHP rental index suggests that nominal rents actually grew by about 3.5% a year, with the higher growth driven by the years after both World Wars as well as the 1965–1985 period. With the necessary caveat that we are measuring market rents rather than average rents, a back-of-the-envelope CPI using the HHP series as the housing component would have overall prices growing by 3.3% a year rather than 3.1% a year.[3] If growth in rental prices before 1985 is understated in the BLS data, then there has been less of an increase in the standard of living in the United States since World War I than was previously understood.

Lastly, we examine the link between housing price increases and supply constraints, in the spirit of Saiz (2010) and Baum-Snow & Han (2019). Land constraints are positively linked to price growth throughout the 20th century, but most sharply during the 1930-

[3]Scholars have argued that "owners' equivalent rent" measures should reflect market rents rather than contract rents (Ozimek, 2013) and have constructed alternate CPIs that use market rents for post-2000 period, for instance the Alternative Inflation Index based on Ambrose et al. (2023). We use market rents for the entire housing component of the CPI both because the BLS treatment of owned housing has varied over time and because the rental component is much smaller than the homeowner component.

1945 period, before the postwar opening of the suburbs, and after 1980. There is also greater evidence that regulatory constraints – as measured at the turn of the millennium – have become a more important driver of cross-city differences in price growth, consistent with the idea that zoning has become a tax (Gyourko & Krimmel, 2021). Our findings also suggest deeper roots of zoning regulations, particularly that land-use regulations are in part driven by expectations of future price growth (Fischel, 2015; Trounstine, 2018).

The rest of the paper is structured as follows. The next section reviews existing sources and data on housing prices in the U.S. over the 20th century, while Section 3 describes the HHP dataset. Section 4 outlines both the compilation of our new housing price indices and analysis of how they compare with existing series. Sections 5-8 present new facts on housing markets before the final section concludes.

2 Existing Twentieth Century Housing Price Series

In this section, we review the existing sources of information on the price of housing in U.S. cities, beginning with rents. While scholars have assembled very long-run rental series for major European cities (Eichholtz et al., 2019; Eichholtz et al., 2021; Eichholtz et al., 2012), very little information on market rents is available for U.S. cities until 2000 (Ambrose et al., 2015). Scholars interested in the history of American rental housing markets have instead relied on BLS surveys of current rents undertaken to compute the CPI. These surveys, which were first done in 1914, form the basis of the rental series underlying the Jordà-Schularick-Taylor (JST) Macrohistory Database for the U.S. (Jordà et al., 2017).[4]

Importantly, the BLS surveys were designed to measure the increase in rents for a rotating panel of rental units. However, existing scholarship has expressed skepticism about the apparently steady downward trend in real rental prices in the postwar era, attributing it to unmeasured depreciation, new technologies, and tenant non-response to the BLS survey (Crone et al., 2010; Gordon & van Goethem, 2007). Between 1942 and the mid-

[4]See https://www.macrohistory.net/database/.

1980s, the survey relied on information from tenants, rather than agents or owners, and non-response by tenants, especially after tenant changes, may have introduced bias to the index of Rent of Primary Residence (RoPR) series. The challenges of accurately measuring rent were long known to the BLS, and the methodology employed by the agency has undergone constant revision over the past century.[5] We discuss these issues in more detail in Section 7, where we examine the implications of the difference between our national rental and the RoPR series for 1914-2006.

The other source of information on rents paid by American households is the census, which first asked this question in 1930. This is the most commonly used source for scholars needing information on the distribution of rents for a specific city or metro area (for instance, see Quigley & Raphael, 2004). As we discuss in the next section, census rents are topcoded in more recent decades, limiting their usefulness for empirical research. Other sources that contain information on housing expenditures by households include the American Housing Survey and the Survey of Consumer Finances (Fetter, 2013). However, these surveys contain limited information on location in early years.

For the sales price of housing, city-level information prior to 1975 is primarily limited to the owner valuations reported in the census (Davis & Heathcote, 2007; Gyourko et al., 2013). Scholars needing information on the price of housing in the U.S. at an annual frequency or over the longer run have otherwise relied on the pioneering work of Shiller (2015), who spliced together several sources of data to create a national housing price index from 1890 to the present:

- For the period 1890-1934, the index is based on a survey of owner valuations taken in 1934 using the owner's recollection of the transaction price and his assessment of its value in that year (Grebler et al., 1956).

- For the period 1934-1953, the index is based on median listing prices from newspaper advertisements from five major cities. An average of 30 newspaper listings was used

[5] For instance, Humes & Schiro (1948, 1949) discuss issues arising immediately after World War II, including changes in tenure and in housing quality, the impact of low vacancy rates and very high rates of non-response.

for each city-year.

- For the period 1953-1975, the index uses data from government-backed mortgage programs (the Home Purchase Component of the CPI). The underlying data are a truncated sample of housing market transactions with the price ceiling for mortgages covered by the programs changing over time.

- For the period 1975-1987, the index uses the home price index created by the Office of Federal Housing Enterprise Oversight. This is a repeat-sales index but includes throughout valuations based on appraisals, as well as open-market transactions, with the relative share of appraisals unclear.

- From 1987 to the present, the Shiller index is the same as the Case-Shiller index, also based on a repeat sales method.

The data sources underlying the Shiller index at different points in time are thus very different from each other. Economists have argued that the Shiller index is particularly difficult to reconcile with other sources around the Great Depression (Fishback & Kollmann, 2014) and that the index appears to understate inflation-adjusted increases in the value of homes from the census, particularly in the 1970s (Davis & Heathcote, 2007). We find evidence in support of these criticisms for the early period of the Shiller index as well as broad agreement with the Case-Shiller index after 1987, which we discuss in Section 4.

The FHFA provides MSA-level sales price indices beginning in 1975, and the S&P/Case-Shiller MSA-specific indices begin in 1987. To our knowledge, the microdata underlying the FHFA series have never been made available to scholars and CoreLogic microdata are considered proprietary can be licensed by researchers only for the 1990s onwards. An important aspect of the HHP dataset is that all of the data and series can be made publicly available. We discuss the dataset in detail in the next section.

3 HHP Newspaper Data

The housing price data in this paper were collected from the real estate sections of city newspapers from the years 1890 to 2006 as part of the Historical Housing Prices (HHP) Project. Before 1890, the secondary housing market was too small to yield a sizable set of listings in all but the very largest U.S. cities and, after 2006, newspapers were increasingly eclipsed by the internet as the primary medium for advertising housing. However, during the twelve decades covered by the dataset, newspapers contain the most consistently collected information on the price of owned and rented housing that can be feasibly collected for a large set of cities over a long time period. We are not the first scholars to rely on newspapers, as Rees & Jacobs (1961), Shiller (2015), and Fetter (2016) did so in their work covering multiple cities at various points in the 20th century. However, the HHP dataset is much broader in scope and, unlike Rees-Jacob and Shiller, adjusts for the mix of properties by within-city location, size, and type.

Transacted sale and rental prices are the ultimate object of interest. Scholars focused on individual cities have been able to collect series of sales transactions, for instance Nicholas & Scherbina (2013) for Manhattan in the 1920s and 1930s. Collecting this type of data requires the survival of records, as well as their scanning from local archives, a process that is infeasible for multiple cities across multiple decades and relevant for only sales and not rentals. Efforts in recent years to scan microfilmed newspaper archives for online repositories such as newspapers.com made it possible for us to sample real estate sections for many cities without a local archival effort. The HHP dataset contains 30 cities, which were chosen to obtain a diverse sample in terms of geography and economic trajectory over the 20th century. The other sample criterion was the existence of a complete newspaper repository for the city that we could access. Table 1 reports our sample cities and newspapers.

Our sampling procedure aimed to identify 150 valid rental and 250 valid sales listings from each sampled newspaper, typically the last Sunday of the month of interest. Research assistants sampled across all columns in the real estate section so that any areas covered

Table 1: Sample City Newspapers and Years

City	Newspaper	Start Year	
		Rent	Sales
Atlanta	*Constitution*	1890	1890
Baltimore	*Sun*	1890	1908
Boston	*Boston Globe*	1890	1890
Charleston	*Post-Courier*	1894	1911
Chicago	*Tribune*	1890	1890
Cincinnati	*Enquirer*	1890	1890
Cleveland	*Plain Dealer*	1894	1890
Dallas	*Morning News*	1890	1890
Detroit	*Free Press*	1890	1890
Houston	*Post / Chronicle*	1896	1900
Las Vegas	*Review Journal*	1948	1943
Los Angeles	*Times*	1890	1890
Louisville	*Courier-Journal*	1890	1890
Memphis	*Commercial Appeal*	1891	1890
Miami	*Herald / News*	1915	1910
Minneapolis	*Star Tribune*	1890	1890
Nashville	*Tennessean*	1890	1890
New Orleans	*Times-Picayune*	1890	1893
New York	*Times / Eagle / Daily / News*	1890	1890
Philadelphia	*Inquirer*	1891	1890
Phoenix	*Arizona Republican*	1910	1910
Pittsburgh	*Post Gazette*	1892	1890
Portland	*Oregonian*	1898	1898
Salt Lake City	*Tribune*	1891	1890
San Diego	*Union*	1907	1890
San Francisco	*Chronicle / Examiner*	1890	1890
Seattle	*(Daily) Times*	1910	1910
St. Louis	*Post Dispatch*	1890	1890
Tampa	*Tribune / Bay Times*	1915	1905
Washington D.C.	*Post*	1890	1890

Note: The table lists the city in the sample, the newspapers that were sampled to obtain the series for each city, and the year in which the city could be added to the sample for both rental and sales listings. See Appendix Table 5 for more details on the sampled papers and access sites.

by the newspaper would be included in the sample. For a listing to be classified as valid, it had to contain (1) a price, (2) size as measured by number of either rooms or bedrooms, (3) property type (house or apartment), and (4) an indication of location within the city. The location could be either an address, an intersection, or an area. See Appendix B Figure 1

for an illustration of an acceptable listing. If the research assistants could not identify at least 150 rentals or 250 sales that met these criteria, they consulted the newspaper from the last Sunday of adjacent months.

For most cities, a substantial volume of listings is available in most years from the 1910s onwards. Exceptions include post-WWII rentals, which were scarce due to federal rent controls. We discuss how we handle these cases in the index estimation in the next section. Most major cities enter the sample in 1890, but some cities enter the dataset later such as Phoenix sales in 1910 and Las Vegas rents in 1948. Differences in observations across cities typically reflect sampling effort rather than systematic features of the data, in particular whether we sampled one newspaper per year or four.[6] The final dataset contains just under 2.7 million observations.

In general, total rooms was used earlier and number of bedrooms later in the sample period; number of stories was a common measure of size for properties for sale in 1890s New York. The summary statistics for the sample can be found in Appendix Tables 3 and 4 for the rent and sales segments, respectively. The modal rental housing unit had about two bedrooms and the modal home for sale had about three bedrooms in most cities and periods. We used a simple machine learning classification algorithm to standardize location information from either the geocoded address, intersection, or neighborhood. We use a set of twenty standardized areas for each city to control for location. We allow the newspaper to define the housing market boundaries in each year, and thus the geographic area covered by the housing market for each city grows over time as the associated metro area expands. Details on the geocoding process can be found in Appendix C.

We rely on listed prices for both rented and owned housing as a proxy for transaction prices. A limitation of our approach is that listing prices may diverge from transacted rents and sales prices, particularly across business cycles (Han & Strange, 2014). Little empirical

[6]Half of the sample was collected prior to the Covid-19 outbreak, and we collected data from four newspapers per year for these cities. The other half of the sample was collected in 2020 and 2021 while navigating campus closures. For this half of the sample, we were able to collect data from one newspaper per year only, typically from May. New York has the largest dataset, reflecting other research being undertaken by some of the authors of this paper on sale and rental housing prices in that city.

work studies the relationship between these prices over the long run, but we expect that the same strategic considerations would have applied in the past, particularly that sellers care about both the transacted price and time on the market and set listing prices with the goal of balancing these objectives (Haurin et al., 2010; Yavas & Yang, 1995). Economists have argued that, especially when hedonic mix-adjustment is applied, listed prices are a powerful predictor of selling prices during normal market expansions and contractions (Horowitz, 1992), even during periods of volatility (Lyons, 2019), but perhaps less so at peaks and troughs (Knight et al., 1994). In any event, a substantial share of houses transact at their exact listing price (Han & Strange, 2016), which is consistent with real estate as a setting where learning valuations is costly (Lester et al., 2017).

We argue that our indices are useful for at least three reasons despite their reliance on listing prices. First, cross sections of our housing price data match up well with the distribution of housing prices from the census in many cities and years irrespective of the business cycle, particularly once we control for number of rooms. While the census data do not contain transaction prices either, the self-reported values have been widely used. In Appendix B, we benchmark individual city-year pairs of the HHP and census data, showing common cases of distributional overlap.

Summarizing the comparison with the census, we typically find either a close alignment of the distributions or a rightward shift in the HHP data relative to the census. To the extent that these rightward shifts are driven by sticky rents or imperfect homeowner knowledge of housing price growth, the HHP data are likely a more accurate snapshot of the housing market in that year. It is also possible that there was positive selection into listings, perhaps due to the cost of placing an ad. Controlling for the size of the unit appears to address rightward shifts to a large degree, suggesting that such selection did occur in some city-year pairs. However, the greatest wedges between market conditions and reported rents in the census are driven by rent control in markets such as San Francisco. Our benchmarking exercise also suggests that the census topcodes are substantially binding in years such as 1970, limiting the usefulness of census valuations for studying the top part

of the housing market. These results can be found in Appendix B.

A second reason our indices are useful in spite of their reliance on listing prices is that our sales price and rental series align well with city-level series from the FHFA after 1975, Case-Shiller after 1987, and the BLS for the final decades of the sample, lending credence to the earlier decades of the HHP dataset. We discuss these comparisons in the next section. Lastly and perhaps most importantly, to date, there existed no annual city-level housing price series for owned housing in U.S. cities before 1975 or market rents for any city before 2000, so a dataset based on listing prices will be a significant resource for researchers.

4 Price Index Construction and Comparisons to Existing Series

Measuring the historical performance of housing markets is challenging because of the difficulty of observing property characteristics back in time. In this section, we discuss how we construct price indices from the newspaper data and compare them to existing sources of information on both national and city-level housing markets for the United States.

In contemporary settings, scholars are often able to observe the same property more than once, allowing the construction of "repeat sales" indices that minimize bias associated with unobserved quality changes (for a useful recent contribution to post-1989 housing price series, see Contat & Larson, 2022). However, constant-quality assumptions can bias these indices (Nowak & Smith, 2020) and the requirement that a housing unit be observed more than once means that indices are often based on a very small portion of the overall market (Nagaraja et al., 2014). A repeat sale index is not possible using newspaper listings, as the full address is not required for listing and the same property is unlikely to appear more than once across samples.

We use a hedonic model with controls for both observed and unobserved housing unit attributes. Shen & Ross (2021) caution that hedonic methods may be biased upwards due to unobserved quality changes. To address unobserved quality changes over the long run,

we use a "rolling windows" methodology (Silver, 2016). Intuitively, this approach avoids a regression where all years of the dataset are combined, which imposes a fixed vector of coefficients on size, type and location variables. The relative price of a housing unit size or location is likely to change substantially over time. Specifically, we employ a rolling window approach using the listings from two, three, or five years in sequential regressions to allow for changes in coefficients for size, type and location over longer periods. This approach better measures the true like-for-like change in prices. We use three-year rolling windows as our baseline, with a step size of one year and sensitivity analysis performed using two- and five-year windows. Indices across rolling window lengths are not identical but overall we do not find large differences between two- and five-year window lengths, especially for sales.

In both sale and rental specifications, the regressors include measures of size, housing type, and standardized location within the metro area as well as the year of listing, which is our principal regressor of interest. For rents, we standardize rental prices so that they are expressed in monthly terms, where necessary, and also include the rental frequency as an additional regressor.[7] We control flexibly for each size measure using dummies, allowing for any individual measure to be missing, with bathrooms rounded to the nearest half. Type is standardized to house or apartment.

The hedonic pricing model is thus the following regression equation, where we create an index for one city at a time. For each city c and for a particular base year BY we run:

[7]Rental frequencies are stated often but not always: approximately 0.77m of our 1.23m rental listings do not have a stated rental frequency. Of approximately 0.46m stated frequencies, the vast majority (0.44m) are monthly with most of the remainder weekly (over 22,000, compared to 6,000 annual). We use city-year thresholds to identify frequencies where not stated. In most cases, this is straightforward as monthly rentals dominate, particularly after WWII. Weekly rentals were more likely to occur in the 1930s than in other decades while annual rentals were most common in the 1890s. To impute rental frequency when it was missing, we compared the three-year rolling average of the 90th percentile for weekly rents with the 5th percentile for monthly, and similarly the 95th percentile for monthly rents and the 10th percentile for annual rents. Values less than 60% of the 5th percentile of monthly rents were classed as weekly, values more than 5 times the 95th percentile were classed as annual, and values between the 5th and 95th percentile were classed as monthly. This rule reduced the number of rental listings with unknown frequency to just 33,000.

$$\ln\left(\text{Price}\right)_{ict} = \alpha + \underbrace{\sum_{\min(Y), y \neq BY}^{\max(Y)} \beta_{cy} \; 1_{(y=t)}}_{\text{Coefficients of Interest}} + \underbrace{\mathbf{X\Gamma}}_{\text{Controls}} + \varepsilon_{ict} \tag{1}$$

The rolling window approach means that we run up to 116 separate regressions for each city, with regressions each covering the base year plus the rolling window size. For example, to create an index with rolling window of size three years, we would run the above regression for 1890-1892 to obtain the coefficient for 1891, 1891-1893 to obtain the coefficient for 1892, and so on (the coefficient for 1890 is assumed).[8] Controls include location within the city, size (rooms, bedrooms, bathrooms, stories), dwelling type (house or apartment) and rental payment frequency.

We then transform (exponentiate) and rebase (to a base year) the year coefficients from the above regression to obtain our indices:

$$\iota_t = \iota_{t-1} \exp\left(\beta_t\right) : t \in \{1891, 2006\} \tag{2}$$

The resulting series can be interpreted as the percentage change relative to the chosen base year BY. We aggregate by population share to create the corresponding national index, with population weights constructed using the metropolitan area population from the Census Bureau and interpolated between census years.[9] In general, the rolling windows and geographic controls reduce price inflation by more for rents relative to sales. See Appendix D Figure 5 for housing price indices with and without adjustments for area. In Appendix D Figure 6 we provide a comparison of our rental and housing price indices with and without rolling windows.

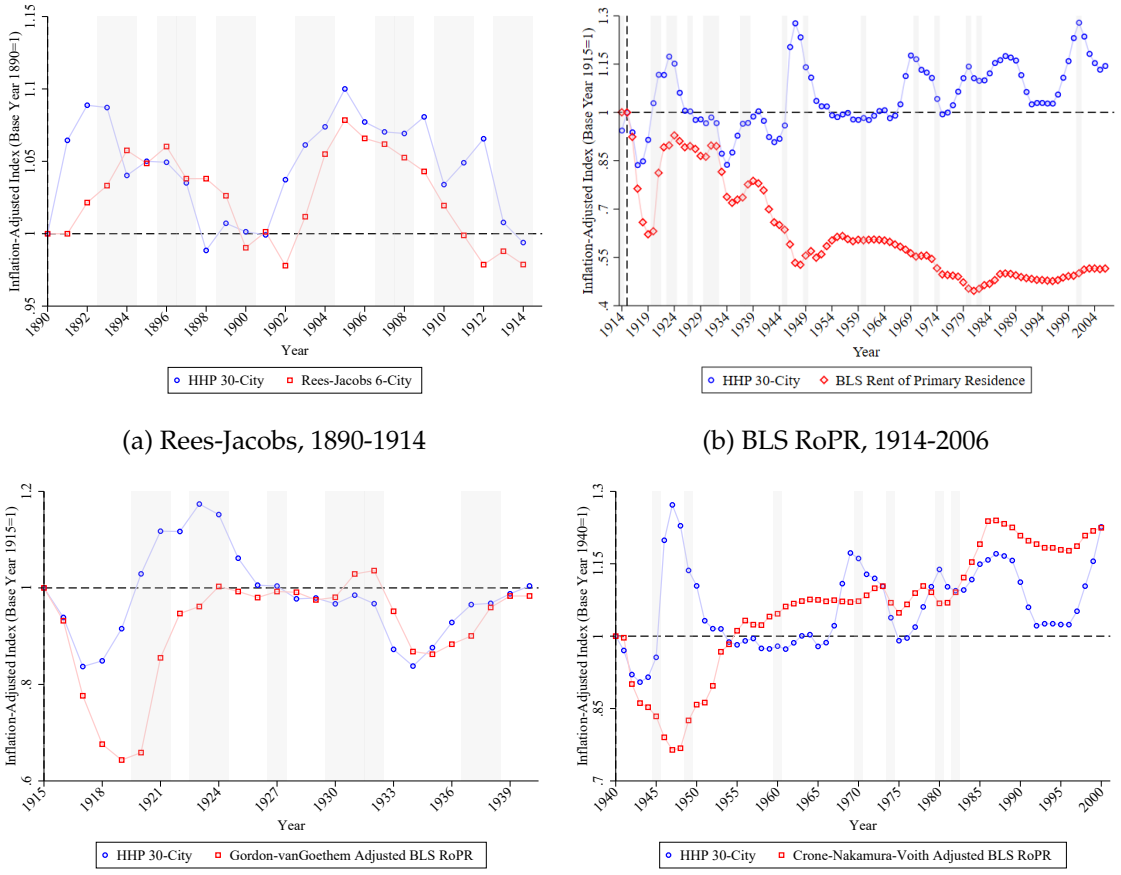
We have relatively low observation counts in the earliest years of the sample for some

[8] If the missing city-year segment was at the start or end of the series, we assigned a weight of zero so that the city contributes to the national index for a particular segment only in years where the city index is defined.

[9] We match our city to the corresponding metro area as defined by the census and allow MSAs to expand over time with population growth. The components of census metro areas we used to construct population counts for the sample period can be found at https://usa.ipums.org/usa/volii/county_comp1a.shtml.

cities in one or both segments. In addition, rental listings were often limited during World War II. To address these cases of lower observation counts, we use a static window of five to ten years to obtain more stable year coefficients. In a few cases and despite our best archival efforts, we were unable to locate a newspaper for a given year and city. In these cases we interpolated across the missing year to obtain index values. All cases of limited and missing observations are listed in Appendix Table 2.

Figure 1: Benchmarking Against Rees-Jacobs and the BLS, 1890-2006



(a) Rees-Jacobs, 1890-1914

(b) BLS RoPR, 1914-2006

(c) Gordon-van Goethem, 1915-1939

(d) Crone-Nakamura-Voith, 1940-1995

Note: This figure shows the baseline HHP national rental price series against the Rees-Jacobs series in panel (a), the BLS Rent of Primary Residence in panel (b), the adjusted BLS Rent of Primary Residence series proposed by Gordon & van Goethem (2007) in panel (c), and the adjusted BLS Rent of Primary Residence series proposed by Crone et al. (2010) in panel (d). All series are in real terms.

The real sales price and rent indices for all 30 cities are presented in Appendix Fig-

ure 4. The city-level figures show that these local housing markets have performed very differently over the 20th century. Some cities saw rents rise since World War I (San Francisco), others had largely flat rents over the whole period (Atlanta), and still others saw rents decline since World War II (Detroit). The extent of sales price growth in the postwar era is also very different across local housing markets. For instance the sales price index of Louisville is largely flat from 1948 to 2000 while sales prices have increased consistently in San Diego since 1970. The city-level series also show local booms and busts. Most prominently, the 1925 Florida land boom is immediately evident in the Miami series (Calomiris & Jaremski, 2023). Interested scholars can download these series from the Philadelphia Federal Reserve. [10] We explore city-level differences in housing markets in Sections 6 and 8.

Before delving into differences across cities, we first compare the HHP series to existing national price series that have been heavily used in economics. We conduct this "benchmarking" exercise chronologically starting with rents. We put our series in real terms to facilitate the comparison.[11] Throughout the paper we include recession shading on each figure corresponding to the NBER recession indicators.[12] The Rees and Jacobs (1961) series is based on the unweighted, unadjusted average rental price from six city newspapers and covers the 1890-1914 period in Figure 1a.[13] The series align surprisingly well given the larger sample and additional controls in the HHP dataset. Both sources reveal similarly volatile rental prices across the period, with prices starting and ending around the same level.

We next compare our market rental index with the BLS "Rent of Primary Residence" (RoPR) series, which has been collected since 1914.[14] This is not a straightforward exercise,

[10] See https://www.philadelphiafed.org/surveys-and-data/regional-economic-analysis/historical-housing-prices.

[11] We use Officer-Williamson (https://measuringworth.com/) for the CPI prior to 1914 throughout this paper.

[12] Federal Reserve Bank of St. Louis, NBER based Recession Indicators for the United States from the Period following the Peak through the Trough [USREC], FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/USREC.

[13] Tables 22 and 32 in Chapter 4 of Rees & Jacobs (1961) provide estimates of market rent indices for six cities and a national index based on the unweighted average of their levels.

[14] The BLS RoPR series can be accessed from the St. Louis Federal Reserve Bank FRED website: U.S. Bureau

as the RoPR series is not intended to capture market conditions. We are nonetheless interested in this comparison since market conditions should converge on average rents over the long run, and the overall trajectory of rental prices is both in dispute and of interest. Figure 1b plots the RoPR against the HHP market rents series. The HHP data indicate that rental prices fluctuated within a relatively narrow band between 1890 and 2006, with real rents in 2006 about 20% higher than those in 1914 or 1890. Rental booms in our period, including peaks in 1923, 1947, 1969 and 1987, were eventually followed by declines in the rental price level. Towards the end of our dataset, real rents peaked in 2001, just surpassing the previous high of 1947, before declining.

The RoPR series does not report flat rental price levels over the same period, with rental price levels appearing to fall by nearly half between 1914 and 2006. Scholars have previously expressed skepticism at this finding and proposed corrections to the RoPR series. We also compare our series to such adjustments proposed by Gordon & van Goethem (2007) for 1915-1939 and Crone et al. (2010) for 1940-1995 in Figures 1c and 1d, respectively. We find reasonably close agreement with the Gordon & van Goethem (2007) series, with both series seeing similar real rental price levels in 1914 and 1939. Our market rents diverge substantially from the adjusted BLS rental series proposed by Crone et al. (2010), as we find rapidly increasing market rental prices after World War II rent controls were removed in the late 1940s. Such rental booms do not appear immediately in the BLS by construction, with new apartment buildings incorporated into the rotating survey panel with a deliberate lag (Ambrose et al., 2015). The Crone et al. (2010) adjustments do not attempt to correct for this. However, we do find agreement with their work in terms of the overall level of growth, with rental prices between 15 and 20% higher in 2006 relative to 1940 in both series.

Our finding of real rental price levels remaining relatively stable over the 20th century accords with the most influential proposed revisions to the RoPR series, which have been

of Labor Statistics, Consumer Price Index for All Urban Consumers: Rent of Primary Residence in U.S. City Average [CUUR0000SEHA]. The CPI we use in this paper is the BLS Consumer Price Index for All Urban Consumers (CPI-U) Database, series [CUUR0000SA0], with the ultimate source being quarterly reports on the Consumer Price Index for the urban U.S.

incorporated into the widely used JST Macrohistory Database for the United States.[15] The RoPR is also available for some cities going back to 1914. We report MSA-level comparisons, where available, in Appendix D Figure 7. Interestingly, some cities *do* exhibit falling real rental price levels in the HHP data, including Detroit and Cleveland. In other cases, the fall in rents in the BLS series is not evident in the HHP data.

We next compare the HHP series for sales prices to the index proposed by Shiller (2015), separating the index according to the underlying data source.[16] One of the main findings about housing discussed in *Irrational Exuberance* is that real housing prices have increased only twice since 1890, first after World War II and second since about 1995. A second finding is the lack of an interwar housing cycle. We revisit both of these findings using the HHP dataset.

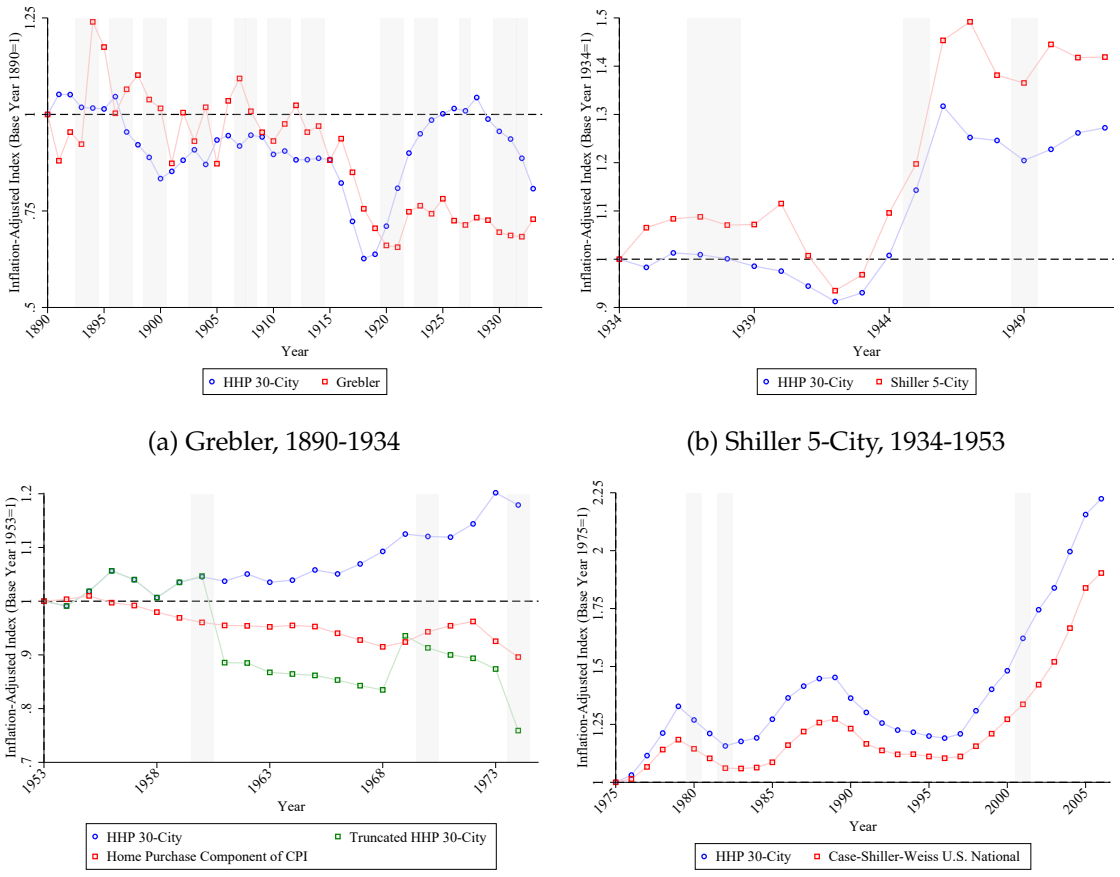
We begin with the Grebler et al. (1956) portion of the index from 1890-1934 in Figure 2a. While our series aligns to a large degree before World War I, the HHP series reports a strikingly different interwar housing price cycle relative to the 1934 survey used by Grebler et al. (1956). This divergence is likely due to homeowners' lack of awareness around the changing value of their homes over the previous decades. Importantly, we find that real housing prices were lower in 1940 than in 1930, consistent with what is reported in the census, Nicholas & Scherbina (2013)'s study of New York City, and Fishback & Kollmann (2014)'s study of New Deal reports. Overall we find that real prices rose by 47% between 1920 and 1928 and then fell by 27% by 1935. Prices did not recover to their 1928 peak until 1946.

Figure 2b shows the relationship between the HHP and Shiller series for the next portion of the latter index, which is based on a simple average of 30 newspaper listings for each of five cities. Here we find less housing price appreciation after World War II relative to Shiller, likely because we are making adjustments for size and location and our sample contains 30 cities instead of five. Specifically, we find that housing sales prices increased by only 27% between 1934 and 1953 as opposed to the 42% reported by Shiller.

[15] See https://www.macrohistory.net/database/.

[16] We obtained these data from Robert Shiller's website, http://www.econ.yale.edu/~shiller/data.htm.

Figure 2: Benchmarking Against Components of the Shiller Index, 1890-2006



(a) Grebler, 1890-1934

(b) Shiller 5-City, 1934-1953

(c) CPI Home Purchase, 1953-1975

(d) Case-Shiller-Weiss, 1975-2006

Note: This figure shows the baseline HHP national sales price series against the various components of the Shiller index. This is the Grebler et al. (1956) survey beginning in 1890 in panel (a), newspaper medians for five cities in panel (b), the Home Purchase component of the CPI in panel (c), and the Case-Shiller-Weiss repeat sales index in panel (d). All series are in real terms.

Next we benchmark to the 1953-1974 portion of the Shiller index, which is the Home Purchase Component of the CPI constructed from a truncated sample of government-backed mortgages. The two series, reported in Figure 2c, suggest very different trajectories for housing prices during this period. In particular, the Shiller index suggests a moderate decline in housing prices of around 10% while we find a 21% increase. Scholars such as Greenlees (1982) have criticized the downward bias of the Home Purchase Component of the CPI due to the exclusion of higher-valued houses as a result of loan limits imposed

by the FHA. However, there was no better source of data available to Shiller at the time. To explore the impact of FHA requirements, we truncate our data using the same statutory limits imposed by the FHA: $30,000 in 1973, $45,000 in 1974, and $60,000 in 1977 as reported in Vandell (1995).[17] Roughly 50% of our sale listings across 30 cities (80,400 of 158,900 listings) from 1971-1979 are excluded if the FHA limits are used. Our truncated data match the Shiller index more closely. Our data thus support the Greenlees critique and suggests real housing prices began rising earlier than 1997, as also argued by Davis & Heathcote (2007).

Finally, we benchmark to the last portion of the Shiller index, which is simply the Case-Shiller-Weiss (CSW) index constructed from repeat sales data. While we find more real price growth relative to the CSW in this period, the two series match very well from the mid-1980s onward. Overall we find about 25% more housing price growth relative to CSW in the 1975-2006 period, with most of the divergence appearing between 1975 and 1980. Why do we find more housing price growth relative to CSW? The CSW series includes Office of Federal Housing Enterprise Oversight (OFHEO) appraisals before 1992, which could potentially understate housing price growth in the 1975-1991 period. The HHP data also include the entire owned housing market instead of just the single-family home market as with CSW, although the bias associated with this difference is not clear. Finally, and perhaps most importantly, the HHP data are limited to 30 major cities instead of the entire country. We find housing prices appreciated by 117% over the 1975-2006 period in those 30 cities compared to the 90% found in the CSW series.

To further explore the performance of the most recent decades of the HHP dataset, we benchmark our sample at the MSA level to the FHFA All-Transaction home price indices (starts in 1975) and the S&P/Case-Shiller home price index (starts in 1987 when available for an MSA) in Appendix D Figures 8 and 9, respectively.[18] The MSA-level indices reveal

[17] These criticisms contributed to the abandonment of the home purchase approach and the adoption of the rental equivalence method in 1983.

[18] The source for the FHFA series is the FHFA All-Transactions Index for MSAs (base year of 1975). These data were accessed from https://www.fhfa.gov/data/hpi/datasets. The S&P Case-Shiller series (when available for the MSA) were accessed from FRED at the Federal Reserve Bank of St. Louis; for instance the

a close agreement when both series are available for most cities, suggesting that compositional effects are important in explaining the difference in housing price appreciation between the HHP and existing series for the last decades of the sample.

The HHP price series for owned and rented housing thus match reliable existing series and underscore the limitations of existing series that have been identified by previous scholars. We view our series as building on the efforts of many generations of economists, statisticians, and government agencies as well as providing novel information on market rents and city-level housing markets. In the second part of the paper, we use the HHP data to revisit several significant questions about the long-term evolution of housing markets in U.S. history.

5 Housing and the Business Cycle

Does the housing cycle follow or lead the business cycle?[19] And how do market rents adjust across booms and busts in the economy? We begin with a simple figure that shows, for the first time, how market rents and home prices have evolved with per capita GDP over the 20th century United States. Specifically, in Figure 3 we plot our baseline national HPI and RPI against the Johnston & Williamson (2008) GDP per capita measure, with the indices based to 1890 and GDP per capita expressed in 1890 dollars.[20] Recessions are shaded in gray, with darker gray denoting sharper contractions in output.

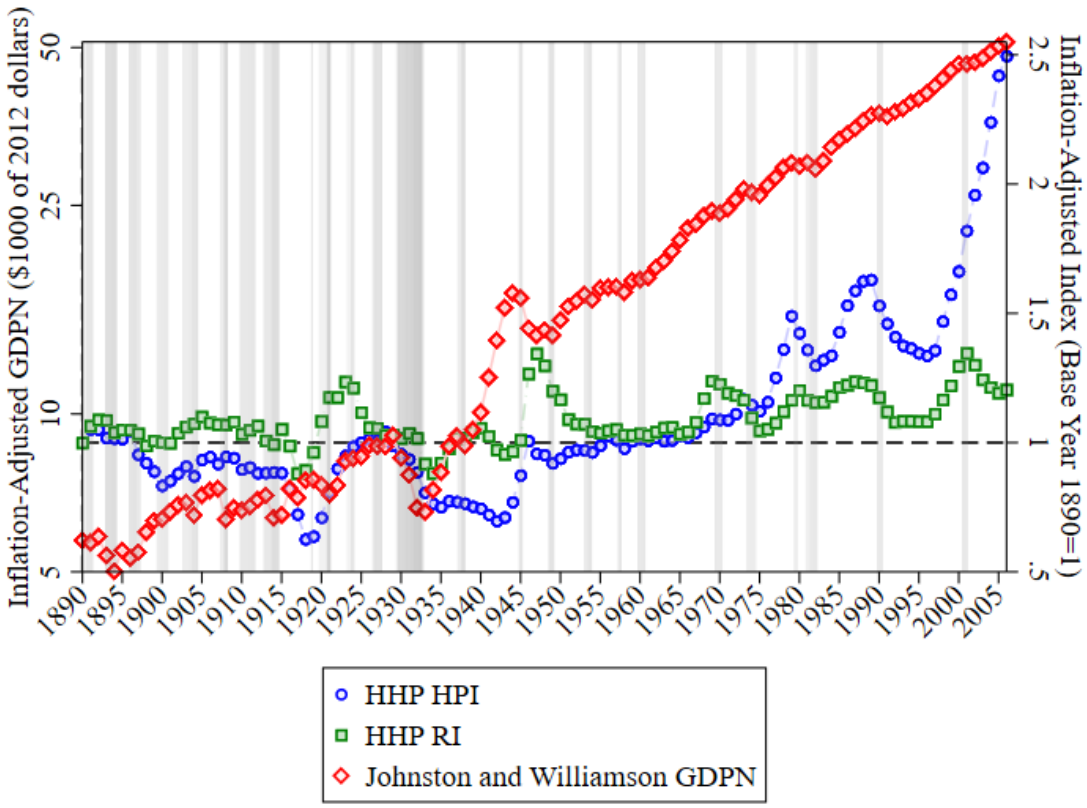
We find that, in line with the research of the last couple of decades, housing and the business cycle are strongly linked over the long run. More often than not, real growth rates in GDP and housing prices move in the same direction in 72 years out of 116 for sales prices and in 65 years for rental prices. Only after World War I (1920-21) and after World War II (1945-46) do we see clear evidence of an economic contraction without any

S&P Dow Jones Indices LLC, S&P CoreLogic Case-Shiller GA-Atlanta Home Price Index was accessed from https://fred.stlouisfed.org/series/ATXRNSA.

[19] Leamer (2015) argues that it is the volume of housing rather than the price of housing that follows the business cycle. We focus here on prices.

[20] Series for GDP and consumer prices were obtained from the "Measuring Worth" website at http://www.measuringworth.org/usgdp/.

Figure 3: HHP 30-City Inflation-adjusted Sale and Rental Indices and GDP, 1890-2006



Note: This figure shows the baseline national HHP sales and rental indices against the Johnston & Williamson (2008) GDP per capita measure, with the indices based to 1890 and GDP per capita expressed in 1890 dollars. Intensity of recession indicated by gradient of shading from light (minor) to dark (major). Left y-axis is log scaled.

equivalent downturn in sale or rental prices. For many of the years where changes in economic output and housing prices did not match, sale or rental prices fell in the years just after a fall in real GDP, such as in the late 1890s and again in the early 1980s. We also document three major economic downturns where the sequence runs the other way, starting with a fall in real rents, followed by a fall in real prices, and then a fall in real GDP. The most obvious is the Great Depression: real rents start to fall in 1924, prices in 1929, and output in 1930. But the same pattern occurs again in the late 1980s, with rents falling from 1988, prices from 1990, and GDP in 1991. Our series ends with rents having fallen from 2002, with falls in prices and GDP to come after our series ends in 2006.

A striking feature of Figure 3 is the relative stability of long-term market rents compared with sales prices, and the permanent divergence of the two series beginning in the 1970s as the price of owned housing began thirty years of volatile growth. Rents surged during the postwar economic booms of the early 1920s and late 1940s, but in both cases real rents fell within a few years to their long-run average. The same pattern was repeated in the late 1990s economic boom. Overall, real rental price levels were within 10% of their 1890 value almost two-thirds of the time, with rental booms exceeding this range in 1921-25, 1945-1950, 1968-73, 1978-91 and 1997-2006. Only in three years did rents fall below 90% of their 1890 level, namely 1917-18 and 1934. Economic downturns were associated with a fall in the rental price level, particularly during the Great Depression and also around 1990. In other cases, rental prices fell during periods of economic *growth* that were accompanied by a surge in housing construction, lending innovations, and homeownership. For instance, the late 1920s, early 1950s, 1970s, and early 2000s all saw housing prices and rental prices move in opposite directions.

On the other hand, real sales prices exhibit more persistent growth and track the business cycle more closely. Sales prices spent most of the 1899-1945 period at less than 90% of the 1890 level (adjusting for inflation), with the major exception of 1923-31. By 1973, prices rose to more than 10% above their 1890 level for the first time and never again went below that threshold. Far from being an outlier economic event that was not associated with a boom and bust in the housing market, the Great Depression saw a dramatic housing price cycle. Our index suggests a 43% peak-to-trough decline in nominal prices between 1928 and 1934 (27% adjusting for inflation due to Depression-era deflation). The recovery in sales prices was long: in nominal terms, the peak of 1928 was only seen again in 1946, while in real terms, it would take four decades, until 1968.

Our series also highlights two earlier price slumps in housing. The first occurred in the early 1890s when prices fell by 11%, although this shift largely matched wider deflation. A more sustained 20% fall in prices happened between 1896 and 1900, but this time consumer prices were stable. These trends align with broader economic conditions, par-

ticularly the Panics of 1893 and 1896. Prices rose during the 1900s and then more slowly in the 1910s. During World War I, nominal housing price growth was far slower than growth in the broader price level, meaning that in real terms home sales prices slumped, bottoming out in 1918 at 40% below the 1896 peak. This second pre-Depression slump was more pronounced, more temporary, and more closely related to surging inflation elsewhere in the economy. In particular, a nominal increase in housing prices of just 10% was swamped by wider inflation of almost 60% from 1914 to 1918.[21] However, sales prices surged from 1918 to 1920 and continued to increase in the early 1920s even as wider price levels fell.

Moving to more recent years, the HHP data also reveal a sizable housing cycle between 1982 and 1996 (consistent with Himmelberg et al., 2005). Prices rose by 37% in inflation-adjusted terms from 1971 to 1979, before falling back 13% by 1982 as housing price gains did not match those in the wider economy. Between 1982 and 1989, however, prices increased in real terms by 25%, only to reverse those gains completely by the mid-1990s. When real prices bottomed out in 1996, they were effectively unchanged from their level in 1982. Lastly, the dot.com recession of 2000 is notable in that it is the only postwar recession that had no apparent impact on the sharp upward trajectory of the sales price of housing.

The long-run link between economic activity more generally and housing prices – both sale and rental – is clearly a fruitful avenue for future research. The city-level price information could be used to bring a longer-run perspective to existing work on housing and the business cycle (Ghent & Owyang, 2010; Davis & Heathcote, 2005). The aggregated annual series above suggest a number of important follow-on questions, particularly related to the obvious difference in trend rates across rent and sales segments since the 1970s. Both segments exhibit cyclical behavior, but in the case of sales prices, this is around an upward, rather than stable, long-run trend. The divergence of the two series also raises topics around the financialization of housing and the role of credit.

[21] As discussed below, if conventional measures of rental inflation understate the increase in these years, then the true inflation-adjusted fall in sales prices will be larger.

6 The Return to Owning Housing in the United States

In this section, we revisit another debate in the literature focusing on the long-run return to homeownership in the United States. Economists have debated the average annual capital gain implied by the national Shiller index (0.7%) and the median census housing value (around 2%) over the period 1940-2000 (for example Davis et al., 2008; Davis et al., 2007). We also contribute to the wider literature on the returns to housing compared with other assets internationally over the long run as presented in Jordà et al. (2019). Their work, covering sixteen advanced economies since the late 19th century, establishes some stylized facts on returns across asset classes, but also a puzzle: while both equities and housing enjoy high real total gains (about 7% a year), housing exhibits lower volatility.

We compute the total return to housing, R, as the sum of the capital gains, H, and the rental return, Y:

$$\underbrace{R_{c,t}}_{\text{Total Return}} = \underbrace{H_{c,t}}_{\text{Capital Gain}} + \underbrace{Y_{c,t}}_{\text{Rental Return}} \tag{3}$$

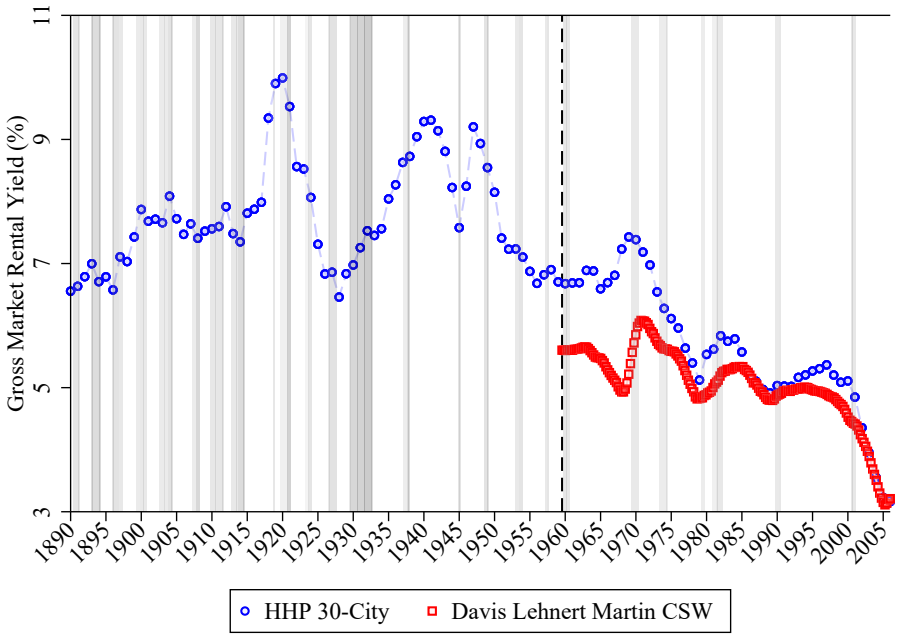
$$= \frac{\text{HPI}_{c,t} - \text{HPI}_{c,t-1}}{\text{HPI}_{c,t-1}} + \frac{\text{RI}_{c,t}}{\text{HPI}_{c,t-1}} \tag{4}$$

The total return to housing R can thus be calculated straightforwardly from our baseline sales price $\text{HPI}_{c,t}$ and rental price $\text{RI}_{c,t}$ indices for city c and year t. We also compute the rent-to-price ratio, or rental yield:

$$Y_{c,t} = \frac{\text{RI}_{c,t}}{\text{HPI}_{c,t}} \tag{5}$$

We weight by the city's population to aggregate each series to the national level. A few additional points are relevant here. Firstly, we define the average annual return for each component of the total return as the arithmetic rather than geometric mean for the purpose of considering the average year in any given period. Specifically, where $t \in T =$

Figure 4: National Rental Yields in HHP vs. Davis Lehnert Martin



Note: This figure plots the HHP gross rental yield from equation 5 benchmarked to the Davis Lehnert Martin series (Davis et al., 2008) in 2006.

$\{1890, 2006\}$:

$$\bar{H}_c = \frac{1}{|T|} \sum_{t=1890}^{2006} H_{c,t} \tag{6}$$

Secondly, we focus principally on nominal returns because the choice of deflator is not straightforward (for instance, see the next section of this paper). Thirdly, we do not attempt to adjust for depreciation or maintenance to avoid making broad assumptions about costs that were highly variable over time and across cities (Harding et al., 2007). Lastly, we calculate the gross rental yield due to changing taxation of rental income over time.

Figure 4 presents the estimated gross market rental yield, back to 1890, benchmarked to the Davis Lehnert Martin (DLM) series, which runs quarterly from 1960 (Davis et al., 2008). By construction, the national DLM and HHP values in 2006 are the same. The series show similar cycles and trends between 1960 and 2006, but the HHP yield in the

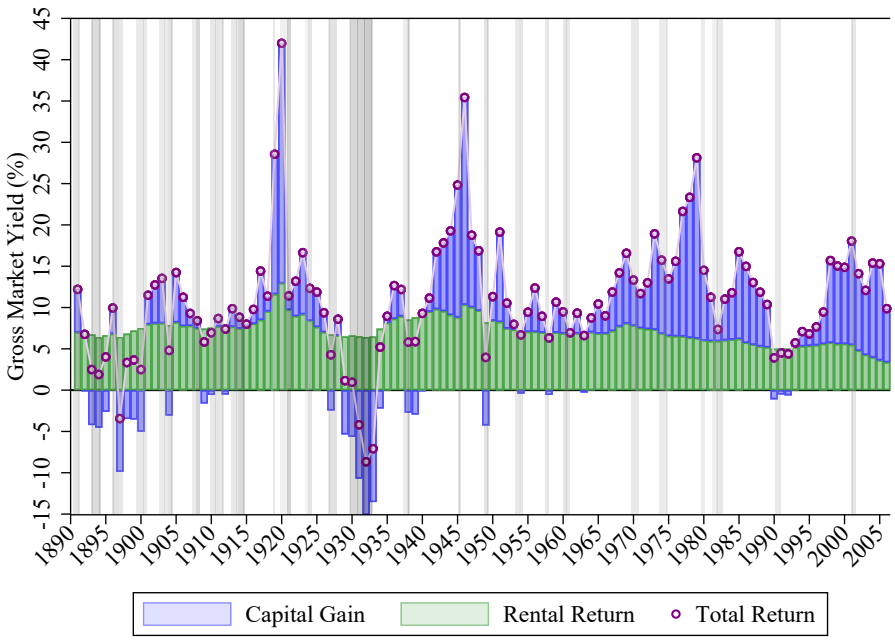
1960s is closer to 7% rather than the 5.5% of the DLM series. This gap is due to the DLM series reliance on BLS rental data, which understates rental price growth during this period relative to the HHP series (see Section 4). Before 1960, the HHP series shows spikes in the yield after both World Wars but also a dramatic fall in the estimated yield in the early 1920s, from almost 11% to below 7%, consistent with a potential bubble emerging before the Great Depression.

Figure 5 presents the estimate of nominal housing return, by year and component, for the U.S. from 1890 to 2006. Four stylized facts present themselves. Firstly, capital gains are significantly more volatile and cyclical than rental returns. Secondly, rental returns, while noticeably more stable overall, declined significantly in the second half of the period relative to the first half. Thirdly, with the notable exception of the immediate aftermath of World War I, capital gains were largely unimportant in overall housing returns until the 1940s. And lastly, capital gains grew to become the dominant component of housing returns for most of the period from 1970 until the end of the sample. The lack of gains in the early 1990s is the only exception to this rule.

We also summarize the city-level return to owning housing by component and by four periods in Table 2. Overall, as presented at the bottom of the table, we find that in the typical year, nominal housing prices increased by 3.8% on average over the full sample (1890-2006), although this was substantially larger after World War II than before, with average nominal gains per year of 6.1% in 1946-1980 and 5.8% in 1981-2006 compared with 1.9% in 1890-1929 and -0.1% in 1930-1945. The typical year in our period saw inflation of 2.8%, meaning that the overall inflation-adjusted capital gain was 0.9%. While inflation was higher after World War II than before, it was not so high as to overturn the stylized fact above: the typical year before WWII saw no capital gains after inflation (0.1% 1890-1929 and -0.6% 1930-1945), while gains after inflation were substantial in later periods (1.5% on average in 1946-1980 and 2.3% in 1981-2006).

Turning to the rental return, we estimate that in the average year from 1890 to 2006, the nominal gross rental return was 7.2%. This is in line with Jordà et al. (2019), who note

Figure 5: Gross Return to Housing (Nominal terms)



Note: The figure plots the total gross return to housing in nominal terms for the full HHP sample. The total return is broken down into the capital gain and rental return components from equation 3.

that rental income for housing contributes more to its overall return than capital gains at the national level. The pattern for rental returns across periods is noticeably different than the pattern for capital gains. For the three earlier periods, the average nominal rental return is similar, 7.9% in 1890-1929, 8.3% in 1930-1945 and 7.4% in 1946-1980. The rental return falls in the final period (1981-2006) to an average of 5.3%. Only in this latter period is the average capital gain greater than the average rental return (5.8% versus 5.3%). In aggregate, therefore, the average nominal housing return in our period is estimated to be 11% per year: 3.8% capital gain and 7.2% from rents. Over the long run, in other words, the return to housing in the U.S. has been dominated by the rental component rather than capital gains. In this regard, the period 1980-2006 was anomalous.

As noted above, one puzzle highlighted by Jordà et al. (2019) relates to the relative lack of volatility of housing returns compared to the other major class of high-return assets, equities. Our city-level series can shed some light on this puzzle. Specifically, unlike equities, housing is fixed in one key aspect – location – and this immobility, coupled with differential trends in the economic opportunity and thus value of land over time, creates very different paths for housing prices and returns across markets.

This idea is illustrated in Table 2, which also reports the various return components associated with housing for each of the 30 HHP cities separately.[22] For the period 1890-1929 (when the typical inflation rate was 2.8%), about of half the sample cities have an average capital gain of less than 2%. However, other cities have average gains above 4%, including Baltimore, San Diego and Miami.[23] During the period 1930-1945, capital gains are generally lower, and indeed negative in six cities, including New York. However, there are cities with substantial capital gains, including Charleston and Miami as well as Los Angeles. In nominal terms, the gains in the period 1946-1980 are within a tighter range

[22]The city-level rental returns reported here are benchmarked to the 2005 American Community Survey computed at the MSA level. We use 2005 as the benchmark value because the Houston and Washington D.C. HHP series end in 2005.

[23]Note that the Baltimore sale series starts in 1908 and the Miami sale series in 1910, so the composition of years covered in the first period is different. Every city with a start date later than 1890 is starred in the total return column. Note that the economic turmoil of the 1890s generally means that cities with later starting dates appear to have higher average returns during the first period of the sample.

but substantial differences remain. There are also very different capital gains across cities in the final period, where the average nominal gains varied from 7.6% in Charleston and New York to below 3.5% in Dallas and Pittsburgh.

Rental returns presented in Table 2 exhibit a downward trend over time in virtually every city, although some cities had consistently higher-than-average rental returns, including Charleston and Portland. Gross rental returns were very high in the two decades before the Great Depression, even over 15% for a few cities, while most of the sample saw rental returns of over 10% in nominal terms during the 1930-1945 period. Rental returns fell across the board by 1980, but even then, Phoenix and St. Louis saw average rental returns of over to 12%.

To give another perspective on these return components, we also compute gross nominal returns for the S&P 500 and long-term returns to holding government debt for the same time periods using data from Shiller (1992). Interestingly, housing outperformed the S&P 500 in several cities before World War II, including New York City and Chicago. However, these findings come with the necessary caveat that we are ignoring running costs and differential tax treatment of housing and equities. In addition, some of the largest housing returns in the 1890-1929 era are for cities that enter the sample in 1910 and thus skipped the turmoil of the 1890s (these cities' total return is starred in Table 2). However, while some cities outperformed the S&P 500, many others did not and thus equities were still a better bet on average in the 1890-1929 period. During the 1930-1945 periods, the opposite was true, underscoring how the comparative performance of housing varies over time.

Rising capital gains were not enough to offset declining rental yields in both postwar periods, and thus gross equity returns exceeded those of housing after 1945. Interestingly, the worst-performing housing markets saw returns at a level close to that of long-term government debt (here a 10-year Treasury note) in the second half of the study period. After accounting for taxes and depreciation, one might have been better off buying treasuries rather than a home in Detroit after World War II.

These results underscore the fact that national housing price series conceal substantial

variation across local markets. Furthermore, the winners and losers at a point in time are not the same thirty years later. At the start of the 20th century, Cleveland appeared to be a better investment than Los Angeles. That the trajectories of these cities diverged so substantially was likely difficult to predict. The relative illiquidity of housing investment is also relevant to this comparison. While individual investors could buy mutual funds relatively easily, diversifying across many housing markets to protect against a manufacturing industry shock would have been impossible.

We close this section by investigating the idea of "superstar cities" in the spirit of Gyourko et al. (2013) and Amaral et al. (2021). These papers find higher housing price growth and lower rental yields in the most high-demand U.S. cities and in the largest European cities, respectively. Our sample is composed only of major U.S. cities, so we do not attempt to assign superstar status. However, we consider the correlation of capital gains and rental returns in our sample. We find a mild positive correlation ($R^2 = 0.24$) between capital gains and rental return. For example, Portland, Oregon, ranks fifth-highest for capital gains and highest for rental return of the 30 cities, while Atlanta ranks 23rd of 30 cities for capital gains and 28th for rental return. Thus, while cities were on different trajectories across the 20th century, we still find that some housing markets were overall a better bet on both dimensions of the return to owning housing without an obvious offsetting effect on rental levels and capital gains.

Table 2: Average Return Associated with Housing Ownership

	1890-1929			1930-1945			1946-1980		
	Cap. Gain	Rental Ret.	Total Ret.	Cap. Gain	Rental Ret.	Total Ret.	Cap. Gain	Rental Ret.	Total Ret.
City									
Atlanta	1.75	4.54	6.28	1.16	6.21	7.37	5.42	4.82	10.24
Baltimore	4.55	8.75	13.30*	1.36	7.69	9.05	6.40	4.99	11.39
Boston	1.90	4.01	5.90	0.06	3.76	3.82	6.08	3.76	9.84
Charleston	3.29	13.45	16.74*	3.48	16.75	20.24	5.51	9.41	14.92
Chicago	3.01	13.69	16.70	0.55	11.41	11.96	4.97	8.93	13.90
Cincinnati	2.36	9.66	12.02	-0.53	9.22	8.69	5.20	9.35	14.55
Cleveland	2.97	12.80	16.03*	0.55	14.24	14.79	5.65	10.64	16.29
Dallas	1.83	9.38	11.21	1.56	10.74	12.30	4.64	9.35	13.99
Detroit	3.44	3.92	7.37	-0.05	5.07	5.02	4.44	5.47	9.91
Houston	3.20	9.82	13.03*	2.21	12.69	14.90	5.91	10.42	16.32
Las Vegas	.	.	.	.	.	.	5.77	9.19	14.96
Los Angeles	2.52	4.88	7.39	3.78	6.18	9.96	6.60	5.81	12.41
Louisville	1.77	13.85	15.62	0.23	12.39	12.62	5.10	10.07	15.17
Memphis	0.50	12.49	12.99*	1.94	16.40	18.34	4.76	11.04	15.80
Miami	6.57	8.72	15.76*	4.78	11.84	16.61	5.81	10.42	16.23
Minneapolis	1.85	8.18	10.02	1.64	8.72	10.36	6.30	6.90	13.20
Nashville	0.89	10.41	11.29	0.30	11.14	11.44	5.76	9.50	15.26
New Orleans	2.67	7.00	9.67*	0.31	7.85	8.15	6.12	6.83	12.95
New York City	2.41	13.18	15.59	-1.20	13.57	12.37	6.66	12.16	18.82
Philadelphia	1.94	9.19	11.13*	-1.57	10.88	9.31	5.91	9.17	15.08
Phoenix	2.00	15.11	17.11*	3.85	18.38	22.23	6.21	13.35	19.56
Pittsburgh	1.69	7.42	9.02*	-1.02	8.02	6.99	5.56	8.33	13.89
Portland	4.44	16.83	21.27*	1.30	20.03	21.32	6.92	16.58	23.50
Salt Lake City	1.21	11.80	13.01*	3.53	15.68	19.21	6.41	10.06	16.47
San Diego	4.33	10.85	14.87*	4.49	12.93	17.42	7.33	8.26	15.60
San Francisco	1.36	6.73	8.09	2.23	7.08	9.31	7.95	5.77	13.72
Seattle	2.17	11.16	13.32*	4.21	13.33	17.54	7.62	8.27	15.89
St. Louis	1.64	11.81	13.46	-2.01	11.71	9.70	6.01	12.43	18.44
Tampa	3.00	8.91	11.81*	3.71	9.05	12.76	6.32	8.46	14.78
Washington D.C.	1.46	5.93	7.39	1.41	7.00	8.41	6.07	5.85	11.92
National	1.87	7.86	9.73	-0.11	8.29	8.18	6.08	7.37	13.45
Asset									
Government Debt	.	.	3.80	.	.	2.73	.	.	4.79
S&P 500	8.15	5.27	13.42	7.15	-0.05	7.09	8.87	7.31	16.17

Table 2, Continued: Average Return Associated with Housing Ownership

	1981-2006			1890-2006		
	Cap. Gain	Rental Ret.	Total Ret.	Cap. Gain	Rental Ret.	Total Ret.
City						
Atlanta	4.41	4.36	8.77	3.37	4.81	8.19
Baltimore	5.32	3.32	8.64	4.89	5.79	10.69
Boston	7.01	2.67	9.68	4.05	3.60	7.65
Charleston	7.59	7.44	15.03	5.32	10.87	16.19
Chicago	5.85	6.37	12.22	3.90	10.30	14.19
Cincinnati	4.06	7.05	11.11	3.20	8.92	12.12
Cleveland	3.46	6.23	9.69	3.55	10.82	14.48
Dallas	2.82	11.18	14.01	2.86	9.96	12.83
Detroit	3.60	5.02	8.61	3.30	4.79	8.09
Houston	3.91	7.76	11.67	4.12	9.96	14.09
Las Vegas	5.29	7.66	12.96	5.56	8.52	14.08
Los Angeles	4.10	4.54	8.64	4.28	5.26	9.54
Louisville	4.13	7.25	11.37	3.09	11.03	14.12
Memphis	5.14	7.69	12.83	3.02	11.52	14.54
Miami	6.71	7.94	14.65	6.03	9.69	15.77
Minneapolis	5.54	4.43	9.97	3.99	7.03	11.02
Nashville	5.93	8.09	14.02	3.41	9.71	13.12
New Orleans	4.51	5.32	9.82	3.83	6.68	10.51
New York City	7.55	7.39	14.95	4.35	11.63	15.98
Philadelphia	5.64	7.47	13.11	3.48	9.03	12.51
Phoenix	6.10	8.99	15.09	4.95	13.35	18.31
Pittsburgh	3.46	6.38	9.84	2.88	7.54	10.40
Portland	7.39	8.87	16.26	5.49	15.31	20.80
Salt Lake City	5.04	7.60	12.64	3.96	10.87	14.83
San Diego	6.98	5.32	12.30	5.85	8.84	14.87
San Francisco	6.41	3.87	10.28	4.60	5.85	10.45
Seattle	6.32	5.34	11.66	5.62	8.89	14.51
St. Louis	6.96	9.19	16.15	3.65	11.40	15.04
Tampa	5.83	8.91	14.74	4.99	8.76	13.93
Washington D.C.	6.23	4.61	10.84	3.89	5.77	9.66
National	5.84	5.25	11.09	3.76	7.19	10.94
Asset						
Government Debt	.	.	7.47	.	.	4.77
S&P 500	6.39	10.92	17.31	7.84	6.41	14.24

Note: This table reports the rental return, capital gain, and total return to housing at the level of the city and nationally, with the city-level series aggregated by population weight to construct the national series. All values are arithmetic means of gross returns in nominal terms. Cities that start after 1890 are indicated with a star on the total return over the 1890-1929 period (third column).

7 Nominal Rental Prices and the CPI

In this section, we explore the implications of our revised housing price series on the measurement of consumer price levels over the 20th century. The treatment of housing in a consumer price index is not trivial and numerous adjustments have been made over time by the Bureau of Labor Statistics (BLS) to reflect evolving trends in the consumption of housing services as well as methodological advances in how the cost of those services is measured. It is particularly difficult to disentangle asset considerations from the services element of owner-occupied housing, particularly over the long run (Eiglsperger et al., 2022). One solution to capturing the underlying housing service is to use imputed rents, i.e. to capture the cost of housing services enjoyed by homeowners through the rent for an equivalent home on the open market. This approach simplifies the calculation of housing services for all households in the market rental and owner-occupied segments, as asset factors such as interest rates or expected capital gains are not relevant.

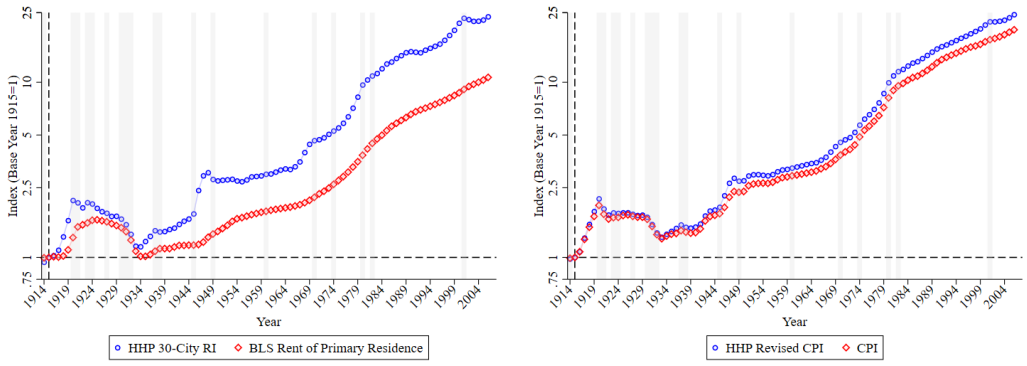
Measuring rents brings its own challenges, however. The first issue stems from the survey-based nature of CPIs: ultimately, the dwelling is the object of interest, rather than the household, but households, not dwellings, respond to the surveys that inform price indices. The reporting by households of changes in rents may be unreliable. As tenants move, vacant apartments may experience a "reset" in rents to market levels, which is a change in rents that will be captured only if the unit is included in the survey under new tenants. This latter source of potential bias was particularly relevant between 1942 (when the BLS changed its methodology from surveying agents and property owners to surveying tenants by mail) and 1985 (when the BLS took steps to correct for vacancy bias). Non-response rates were as high as 30% by 1947 (Humes & Schiro, 1949), just as (by our measure) there was a spike in market rental prices.

The second set of challenges relates to adjustments in the quality of housing, especially over the long-run. The quality of a given dwelling will change over time. This could be downward, due to imperfect maintenance, or upward through improvements made by

the landlord or tenant. Further, over the long run, the quality of rental dwellings will fundamentally change, for instance with the adoption of central heating in the early 20th century. While the BLS Rent of Primary Residence (RoPR) measure attempts to correct for all these factors, corrections were not applied retrospectively, and the RoPR measure has never been comprehensively revised.[24]

We construct an alternate CPI using our HHP rental indices that addresses some of the known issues with the RoPR series. Our analysis is in the same spirit as efforts to revise the RoPR measure such as Crone et al. (2010), who present a revised BLS RoPR series for the period 1940-2000, and the Penn State Alternative Inflation Rate (Ambrose et al., 2023), which uses repeat rents to capture quality-adjusted changes for the period beginning in 2002.[25] Specifically, we use the HHP rental series to compute an alternate CPI for the entire 1914-2006 period for which the measurement of housing services is constant.[26]

Figure 6: Alternate Indices of Rental and Consumer Prices



(a) Rental price indices

(b) Consumer Price Indices

Note: Panel (a) of this figure plots the baseline HHP rental price series against the BLS RoPR series with base year of 1914. Panel (b) plots the Consumer Price Index for Urban Consumers from the BLS and an alternate CPI that has the total housing component replaced in every year with HHP rental price series.

[24] See https://www.bls.gov/cpi/methods-overview.htm.

[25] See https://sites.psu.edu/inflation/.

[26] We use the BLS RoPR residence and CPI for all urban consumers throughout this section. These series can be accessed through the Federal Reserve Bank of St. Louis FRED website, for instance series CUUR0000SEHA (Consumer Price Index for All Urban Consumers: Rent of Primary Residence in U.S. City Average) for the RoPR and the BLS Consumer Price Index for All Urban Consumers (CPI-U), series [CUUR0000SA0] for the CPI.

In Section 4, we showed a contrast between inflation-adjusted rents reported in the BLS series and our HHP rent index. Here, we consider the two series in nominal terms to better understand the implications of the HHP rental series for our understanding of the consumer price index over the 20th century. Figure 6a presents the two series in nominal terms with a log scale. Cumulatively over the period 1914-2006, the HHP index of market rents rises by a factor of 25.2 compared to just 10.7 for the RoPR series. For context, the CPI excluding shelter index rises by a factor of 24.9 in the same period. In annual growth terms, our rent index is one percentage point greater than the existing RoPR index: 3.6% per year versus 2.6%. This would put housing inflation slightly above inflation in the wider economy rather than well below as the annual average increase in CPI ex-shelter over the same period was 3.3% per year.

The question is whether rents during the 1914-2006 period rose slightly faster than wider prices, as per HHP, or by less than half as much as wider prices, as per the RoPR series. Given the wider context of concerns about the RoPR measure, the mix-adjustment involved in our series, and the rolling-windows specification to allow for changes in unobserved housing quality, we believe that it is more plausible that rents increased in line with prices in the wider economy rather than well below.

Comparing the HHP and RoPR series provides insight not only on the potential extent to which rent increases were understated over the long run but also about the timing of potential mismeasurement of rental inflation. The three biggest contributors to the difference are 1914-1920, the 1940s, and 1965-1980. The first two periods are associated with both World Wars and significant inflation in the wider economy at a time of rent controls. One would expect an *a priori* difference between a series capturing open-market rents (as per HHP) and one capturing average contract rents (as per RoPR) during a period that combines rent controls and high inflation. However, these differences should disappear as controls are lifted and as tenants move to new market-rate units.

The first significant difference between the indices is the 1914-1920 period, when the increase in the RoPR series (35%) is less than one third of the increase seen in the HHP

series (125%). And indeed, this is partly offset by the RoPR increasing over 1920-1925 while market rents fell slightly. Between 1914 and 1925, nominal rents increased by 65% by the RoPR measure and by 103% in the HHP measure, which is an average growth rate of 4.6% per year compared to 6.7%, respectively. Given the nature of BLS measurement at that time, where the underlying data were from surveys of agents, this finding is consistent with tenant rents reflecting market rents with a lag.

A similar pattern occurs after World War II. According to our HHP measure, open-market rents rose by more than one third in 1946 alone (36%) and this increase was followed by a further 21% increase in 1947. Combined with another increase in 1948, this meant market rents were 72% higher in 1948 than in 1945, while the RoPR increased by just 11% over these three years. The RoPR measure of nominal rents continued to rise in subsequent years, while the HHP measure stagnated as the postwar spike eased. In the decade from the introduction of rent controls in 1942, the HHP measure of rents rose by 80%, compared to an increase of 30% in the RoPR.

The final period during which the two series differ, 1965-1980, is also one of high inflation in the wider economy. For the fifteen year period in total, our estimate is that market rents tripled while the RoPR doubled. While measured inflation was similar for 1969-1977 (at roughly 45%), there are substantial differences in estimated rental inflation before and after. Between 1965 and 1969, the HHP measure increased by almost 40%, compared to less than 10% in the BLS measure. Similarly, between 1977 and 1980, the HHP measure saw twice the increase (52% vs 25%) of the BLS measure. The timing of the divergence strongly suggests that the different path of vacant and occupied rental dwellings is at the core of the differences between the published RoPR series and our measure of mix-adjusted market rents.[27]

We compute a simple alternative inflation measure with two components. We use

[27] This "vacancy effect" resulted in a major change in CPI methodology between 1978 and 1985. In 1978 the number of units surveyed was reduced, with effort redistributed to reducing the non-responses, including surveying the landlord or owner. An analysis by Rivers & Sommers (1983) of 18 months of responses from both existing and new tenants from October 1979 to March 1981 found that new tenants faced significantly higher inflation (18.6% annualized compared to 8.1%). Thus a share of true inflation was unmeasured when vacant units were omitted.

the HHP rental series for the housing component and the CPI excluding-shelter index for all other prices in the economy.[28] To compute the two-component index, we need to know the consumption share of housing in each year. Estimates of the housing share in expenditure are available annually from 1984 and for eight benchmark years before this.[29] Ozimek (2013) argues that market rents should be used for the homeowners' equivalent rent portion of the housing component while a measure of existing contract rents should be used for the rental portion. We use rents for the entire housing component for simplicity while acknowledging that our market-based measure may be inappropriate for the rental portion (which is in any event much smaller than the homeowners' portion). The resulting CPI is plotted in Figure 6b.

For ease of comparison, we summarize the decadal differences between the two CPIs in Table 3. The first column shows the average growth rates of the traditional CPI measure based on the RoPR, while the second gives the changes from an alternate CPI where the HHP measure of rents is used to calculate changes in the shelter component. Consistent with the above discussion of the differences in the two rental series, we see the greatest divergence in the decades of 1935-1945, 1965-1975, and 1975-1985. For instance, the average growth rate in the HHP CPI is 7.6% relative to the RoPR CPI of 7.2% in the decade 1965-1975. The calculations presented here suggest that the long-run increase in living costs has been understated in standard CPI measures, and thus the long-run increase in the standard

[28] The CPI excluding shelter can be obtained from the Federal Reserve Bank of St. Louis FRED website, for instance series CUUR0000SA0L2 (Consumer Price Index for All Urban Consumers: All Items Less Shelter in U.S. City Average).

[29] We took estimates of housing's share of consumption from various sources. For 1890 we used "Cost of Living of Industrial Workers in the United States and Europe, 1888-1890" (ICPSR 7711) accessed from https://doi.org/10.3886/ICPSR07711.v4. For 1901 we used the 18th Annual Report of the Commissioner of Labor (1904), Table III. For 1919 we used the "Cost of Living in the United States," Bulletin of the U.S. Bureau of Labor Statistics, #357, May 1924. For 1936 we used "Changes in Cost of Living In Large Cities In the United States, 1913-41," Bulletin of the United States Bureau of Labor Statistics, No. 699. For 1944 we used "Consumer Spending in WWII: The Forgotten Consumer Expenditure Surveys." U.S. Bureau of Labor Statistics, Monthly Review, August 2015. For 1950 we used Bureau of Labor Statistics Bulletin No. 1097 - "Family Income, Expenditure and Savings in 1950." For 1961 we used Table B-9 from the 1962 Consumer Expenditure Supplementary Tables. For 1973 we used Table 1 from the 1972-73 Consumer Expenditure Survey. We interpolated between these years to obtain an estimate of the housing expenditure share in each year prior to 1984. From 1984 to 2006, we calculated the housing share from the Consumer Expenditure Survey. These series were accessed from the Bureau of Labor Statistics Data Explorer at https://beta.bls.gov/dataViewer/view/timeseries/CXUHOUSINGLB0201M and https://beta.bls.gov/dataViewer/view/timeseries/CXUTOTALEXPLB0101M.

of living has been overstated for the urban United States.

Table 3: Decadal Differences in the CPI by Shelter Series

	CPI (RoPR)	CPI (HHP)
1915 - 1925	5.67	6.06
1925 - 1935	-2.42	-2.41
1935 - 1945	2.74	3.23
1945 - 1955	4.06	4.22
1955 - 1965	1.64	1.74
1965 - 1975	5.50	5.90
1975 - 1985	7.17	7.64
1985 - 1995	3.54	3.32
1995 - 2006	2.84	3.14

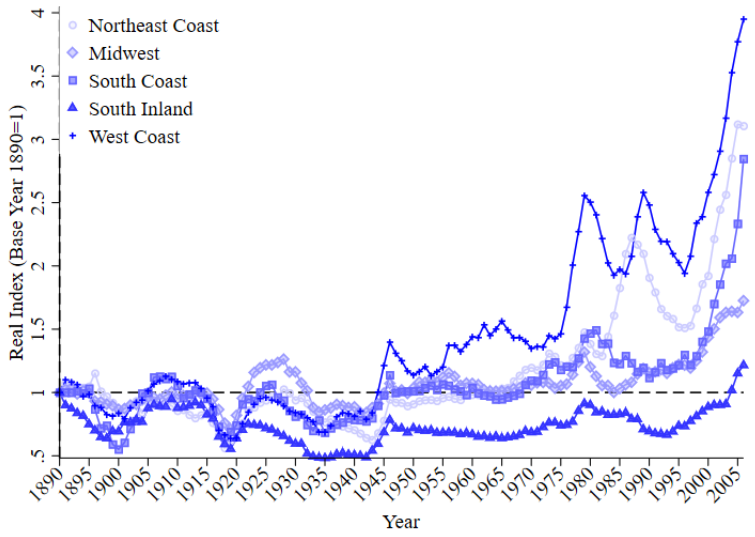
Note: This table shows the average annual growth rate in price levels by decade both for the Consumer Price Index for Urban Consumers and for an alternate CPI with the housing component replaced with the HHP rental series.

8 Why Did Housing Price Trajectories Vary Across Cities?

We have thus far shown that the sales price of housing has increased at several points over the 20th century, particularly beginning in the 1970s. However, we document different degrees of price growth across cities. For instance, in Figure 7 we show real housing price appreciation by region: the Northeast, the Midwest, the southern coasts, the inland South, and the West Coast. The smallest cumulative increases in inflation-adjusted housing prices occurred in cities on the coasts of the southern Atlantic and Caribbean Sea as well as inland areas in the southern half of the country (we include Salt Lake City in this latter group) while the largest increases occurred in the West Coast cities. As shown in Table 2, increases in the home prices of West Coast cities were observable before the late 1940s. In other regions of the Unites States, prices in the 1950s – and in some cases in the 1980s – were similar in real terms to what they were in 1890 or 1910.

In this section we examine why housing prices may have increased at different rates across cities over the long run. The canonical models of housing prices emphasize the cost

Figure 7: HHP 30-City Real HPI by Region, 1890-2006



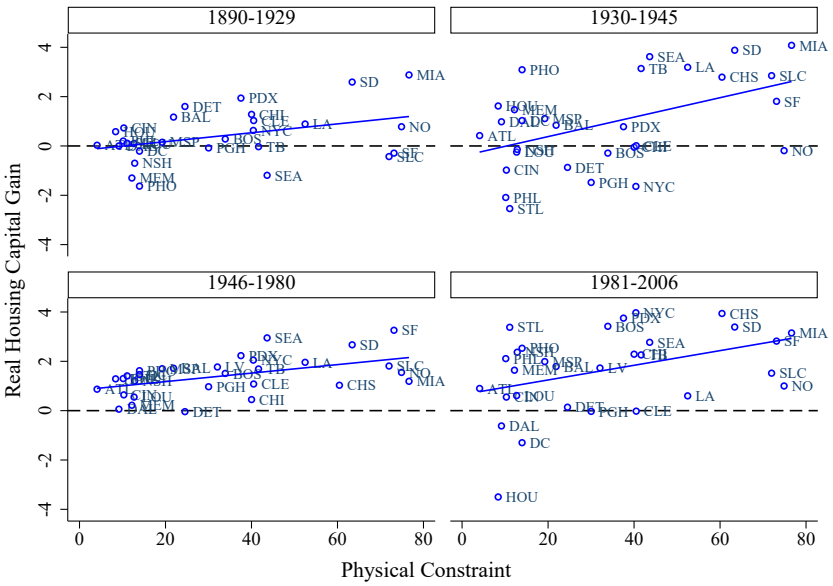
Note: This figure shows the HHP sales price indices aggregated by city population to the regional level with all regions having a base year of 1890.

of land, the cost of building materials, productivity, consumption amenities, and interest rates (for example, Glaeser & Gottlieb, 2009; Poterba, 1984; Saiz, 2010). All of these factors, even the cost of financing, can vary across cities. We focus on two factors, land availability and land use regulation, and ask how they shaped housing price appreciation at different points over the 20th century.

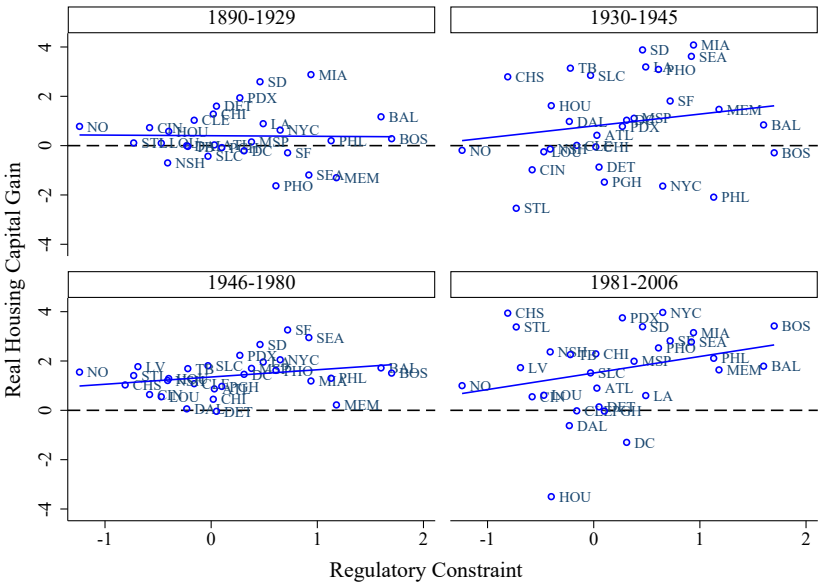
We take our measures from the seminal work of Saiz (2010), which reports both physical and regulatory constraints on housing supply for a large sample of cities, including all of the cities in the HHP dataset. In Figure 8a we present simple scatterplots of the average annual real capital gain at the city level plotted against the Saiz measure of land availability for four periods. The land availability measure is based on topography and water and is thus invariant to development at a point in time.

The findings are surprising. One may have expected that land availability would become more important over time as cities became more developed, and in fact Saiz (2010) shows that land availability was positively associated with housing price growth (as measured by the census) between 1970 and 2000. Yet we find the steepest gradient between

Figure 8: Correlations Between Constraints and Real Housing Price Growth



(a) Physical



(b) Regulatory

Note: Panel (a) shows the correlation between the city capital gain and the Saiz (2010) measure of land availability over each of four time periods. Panel (b) shows the correlation between the city capital gain and the Saiz (2010) measure of zoning stringency over each of four time periods.

price growth and land availability over the 1930-1945 period (coefficient of .04). This was before the postwar opening of the suburbs, with the associated construction of highways in the 1950s and 1960s (Baum-Snow, 2007; Brinkman & Lin, 2022). These figures suggest that the twin technologies of the private automobile and highways increased the amount of land available to house the city's population, which reduced the correlation between price growth and land availability between 1946 and 1980 (coefficient of .02). The land gradient coefficient increases again after 1980 (.03), suggesting that land constraints were again beginning to bind. We speculate based on the evidence presented here that land availability was less closely related to housing price growth in periods seeing expansions of the urban frontier such as in the early 1900s (when most cities still had accessible vacant land) and after World War II (when many new suburbs were established).

We next produce a set of scatterplots with the HHP annual average capital gain plotted against the regulatory constraint from Saiz (2010), which is based on the Wharton Residential Urban Land Regulation Index (Gyourko et al., 2008). The regulatory index measures constraints on development from a survey done at the very end of our sample period. However, social scientists have pointed out that high and growing home prices incentivize the adoption of restrictive zoning (Fischel, 2001; Trounstine, 2018). It is thus informative to see how home price appreciation earlier varied with the regulatory environment of a city at the turn of the millennium.

Figure 8b shows the correlation in each period. There is almost no relationship between real housing price growth and the restrictiveness of zoning in the 1890-1929 period (coefficient of -.02). Zoning was adopted by almost every city in our sample during the 1920s. We see a slightly steeper gradient over the next two periods (coefficients of .48 and .29, respectively). In these periods it is possible both that the existing zoning regimes were causing higher price growth and that home price appreciation was incentivizing cities to adopt even more restrictive measures, particularly by the 1970s (Fischel, 2015; Molloy et al., 2020). The gradient in the final period (1980-2006) is even steeper, however (coefficient of .67), suggesting a closer relationship between zoning and home price appreciation towards

the end of the 20th century. The fundamental endogeneity here is difficult to unpack without better information on historical zoning regimes. However, that land use regulation has become a more important correlate of across-city differences in housing price growth over time is consistent with recent scholarship (Gyourko & Krimmel, 2021).

9 Conclusion

In this paper we examined housing price dynamics in American cities over the long run. We constructed, for the first time, annual market price indices for both rented and for-sale housing for 30 cities and the nation covering the period 1890-2006. Our work confirms and revises many issues identified with existing data and series in the literature, extends our understanding of housing market conditions within and across cities and business cycles and over the long run, and documents several new stylized facts about U.S. housing markets. The data series produced by this paper include rental prices, sales prices, capital gains, rental returns, total housing returns, and rent-to-price ratios for cities and the U.S. as a whole as well as an alternative CPI constructed from the HHP rental data. Our hope is that these new series will be of great use to future researchers and spur new inquiry into the evolution of housing markets in the United States.

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B Data

Newspaper Data

Here we provide further detail on the dataset covering our 30 cities, beginning with the newspapers from which we sampled real estate sections. We then benchmark these data to the decennial census, the most commonly used source of housing data for U.S. cities.

The listings from each city were obtained by sampling the residential real estate sections of newspapers published in each city. Our sampling procedure aimed to identify 150 rental and 250 sales listings from each sampled newspaper edition, typically the last Sunday of the month of interest. Research assistants sampled across all columns in the real estate section so that all areas covered by the newspaper would be included in the sample. They then randomly highlighted a set of listings to be digitized that contained (1) a price, (2) size as measured by number of either rooms or bedrooms, and (3) an indication of location within the city. The location could be either an address, an intersection, or an area. If the RAs could not identify at least 150 rentals or 250 sales that met these criteria, they would consult the newspaper from the last Sunday of adjacent months.

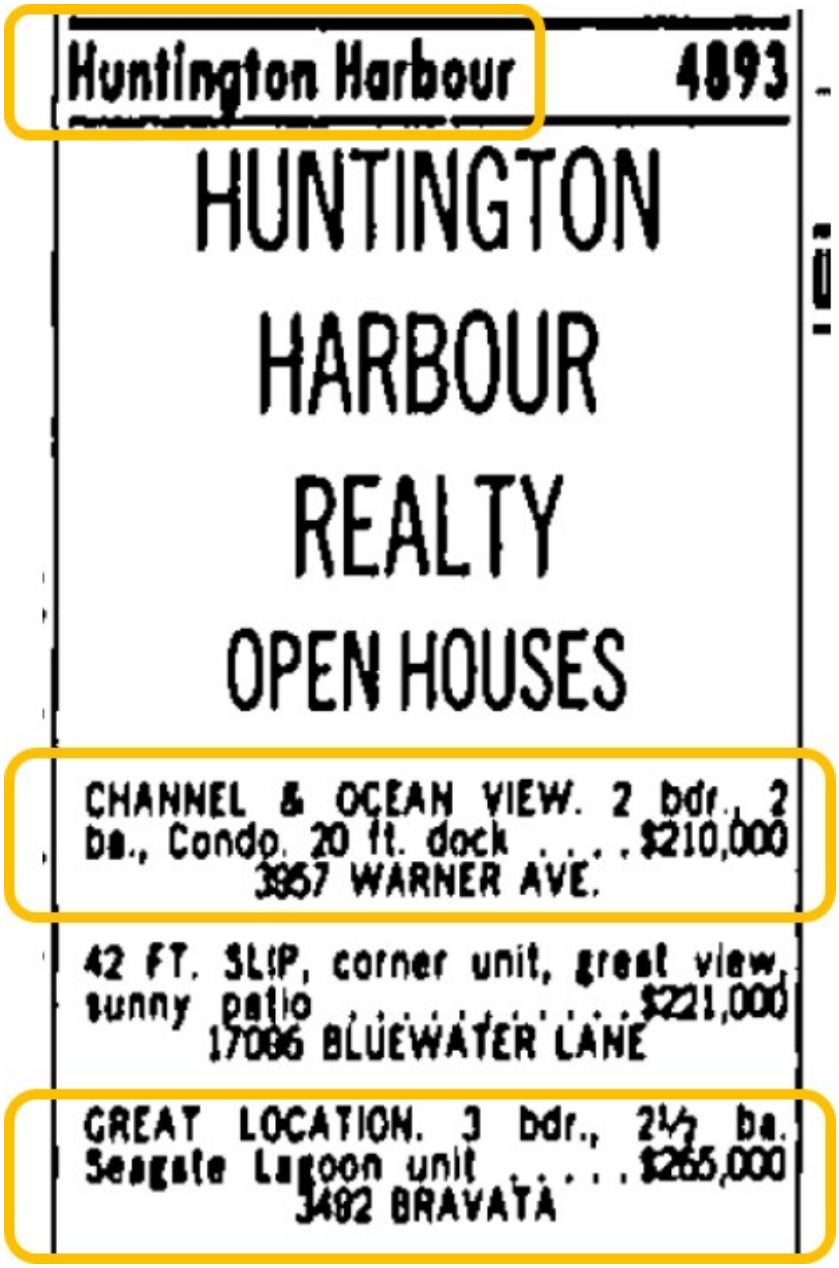
See Figure 1 for an illustration of acceptable listings from the *LA Times*. The neighborhood assigned to these listings would be "Huntington Harbour" from the column heading. The first and third listings (in yellow blocks) are valid listings because they contain a price, a measure of size (bedrooms), and are clearly houses for sale. They also have an address in addition to the neighborhood. These are the types of listings we use to train our city area algorithm (see Appendix C for details). The second listing is not valid because there is no measure of size.

Table 1: Newspapers and Access Sites

City	Newspapers Sampled	Access Site
Atlanta	*Atlanta Constitution* (all years)	Newspapers.com; NYPL
Baltimore	*Sun* (all years)	Newspapers.com; NYPL
Boston	*Boston Globe* (all years)	ProQuest
Charleston	*Post-Courier* (all years)	Genealogybank.com; NYPL
Chicago	*Chicago Tribune* (all years)	ProQuest
Cincinnati	*Cincinnati Enquirer* (all years)	Newspapers.com
Cleveland	*Plain Dealer* (all years)	Genealogybank.com
Dallas	*Dallas Morning News* (all years)	dallasnews.com; Genealogybank.com; NYPL
Detroit	*Detroit Free Press* (all years)	Newspapers.com
Houston	*Post* (to 1924)	Newspapers.com
Houston	*Chronicle* (from 1924)	Genealogybank.com; HPL
Las Vegas	*Review Journal* (all years)	Genealogybank.com
Los Angeles	*LA Times* (all years)	Newspapers.com; NYPL
Louisville	*Courier Journal* (all years)	Newspapers.com
Memphis	*Commercial Appeal* (all years)	Genealogybank.com
Miami	*Miami Metropolis/Daily News* (1910-1940)	Newspapers.com
Miami	*Miami Herald* (from 1920)	Newspapers.com
Minneapolis	*Star Tribune* (all years)	Newspapers.com
Nashville	*Tennessean* (all years)	Newspapers.com
New Orleans	*Times Picayune* (all years)	Newspapers.com; NYPL
New York City	*New York Times* (all years)	ProQuest
New York City	*New York Daily News* (from 1980)	Newspapers.com
New York City	*Brooklyn Daily Eagle* (1890-1940)	Newspapers.com
New York City	*Bronx Homes News* (1907-1940)	BCA
Philadelphia	*Philadelphia Inquirer* (all years)	Newspapers.com
Phoenix	*Arizona Republic* (all years)	Newspapers.com
Pittsburgh	*Post Gazette* (all years)	Newspapers.com
Portland	*Oregonian* (all years)	Genealogybank.com
Salt Lake City	*Tribune* (all years)	Genealogybank.com; NYPL
San Diego	*Union* (all years)	Genealogybank.com
San Francisco	*San Francisco Chronicle* (all years)	Genealogybank.com
Seattle	*(Daily) Times* (all years)	Genealogybank.com; NYPL
Washington D.C.	*Washington Post* (all years)	ProQuest; NYPL

Note: The table lists the newspapers we consulted for each city and years in cases where multiple newspapers were consulted for a single city. NYPL refers to New York Public Library; HPL refers to Houston Public Library; BCA refers to Bronx County Archives.

Figure 1: Example of a Valid Listing



Note: A sample real estate listing from the LA Times in 1980.

We included a city in the dataset if we could consistently obtain at least 30 valid listings for a year in a particular segment. As a result, while most major cities start in 1890 for both sales and rental listings, some cities enter the dataset later; while Miami and Phoenix sales listings start in 1910, the latest is Las Vegas, where housing market sales listings existed in sufficient numbers only from 1943. The start date for the sales and rental series are listed

in Table 1. We digitized only purely residential listings and disregarded any listings that made mention of commercial or industrial uses, or listings that appeared to mix owned and rented housing. We also disregarded listings that described an entire building or a single room for rent, including any sublet units.

We report the observation counts for each city in Table 2. The difference in observation counts across cities reflects sampling effort rather than anything systematic about the newspapers. Half of the sample was collected prior to the Covid-19 outbreak, and we collected data from four newspaper editions per year for these cities. The other half of the sample was collected in 2020 and 2021 while navigating campus closures. For this half of the sample, we were able to collect data from one newspaper per year only, typically from May, before running into resource constraints. We also collected extra data for New York City for a related book project by two authors of this paper.

Table 2: Observation Counts and Missing and Low Count Years

City	Total Number of Observations	Missing/Low Count Years
Atlanta	120,480	*1944-1947* (rent)
Baltimore	38,401	**1890-1907** (sale)
Boston	149,462	–
Charleston	30,873	**1890-1893**, *1895*, *1900-1905*, *1907*, *1908*, *1918-1920*, *1942-1944* (rent) **1890-1910**, *1933* (sale)
Chicago	166,788	–
Cincinnati	162,363	–
Cleveland	46,446	**1890-1893**, *1895*, *1919* (rent)
Dallas	124,054	*1892*, *1894*, *1895*, *1945*, *1946* (rent) *1892-1894* (sale)
Detroit	105,091	*1947* (rent)
Houston	37,912	**1890-1895**, *1899-1901*, *1946*, **1964**, **2003**, **2006** (rent) **1890-1899**, *1900*, *1925*, *1927*, **1964**, **2006** (sale)
Las Vegas	22,604	**1890-1942**, *1951* (rent) **1890-1942** (sale)
Los Angeles	152,279	*1946* (rent)
Louisville	128,637	*1946* (rent)
Memphis	41,212	**1890**, *1892* (rent)
Miami	85,075	**1890-1914**, *1915*, *1916* (rent) **1890-1909**, *1910*, *1911*, *1915* (sale)
Minneapolis	44,822	*1946* (rent) *1896* (sale)
Nashville	39,446	*1920*, *1945*, *1946* (rent) *1897* (sale)
New Orleans	131,841	**1890-1892** (sale)
New York	275,222	–
Philadelphia	145,421	**1890** (rent) *1890*, *1892*, *1894* (sale)
Phoenix	104,048	**1890-1909**, *1910*, *1911*, *1913*, **1931**, *1944*, *1945* (rent) **1890-1909**, *1915*, *1916*, **1931** (sale)
Pittsburgh	48,191	**1890-1891**, *1946*, *1947* (rent)
Portland	42,068	**1890-1897** (rent) **1890-1897**, **1993**, **1995** (sale)
Salt Lake City	38,084	**1890**, *1900*, *1942*, *1946* (rent) *1894*, **2005** (sale)
San Diego	35,416	**1890-1906**, **1944**, **1985**, **1986** (rent) *1896*, *1900*,*1915-1917* (sale)
San Francisco	143,422	–
Seattle	31,299	**1890-1909**, 1943, 1945, 1946, *1947*, *1949* (rent) **1890-1909**, *1944* (sale)
St. Louis	45,788	*1946* (rent)
Tampa	33,594	**1890-1914**, *1921* (rent) **1890-1904**, *1908*, *1910* (sale)
Washington D.C.	125,009	**2006** (rent) **2006** (sale)

Note: The table lists the sample city, the total number of observations for the city, and the missing (bold) and low count (italicized) years for the city.

Table 3: Rent: Real Median Price vs Modal Size

	Rent					
	Median Price (2006 dollars)			Modal Size		
	1890-1939	1940-1969	1970-2006	1890-1939	1940-1969	1970-2006
City						
Atlanta	581	554	841	6	2	2
Baltimore	472	544	610	6	2	3
Boston	460	565	1,275	5	2	2
Charleston	386	418	653	6	2	2
Chicago	776	784	961	6	2	2
Cincinnati	525	582	577	4	2	1
Cleveland	559	668	594	5	2	2
Dallas	467	586	928	5	2	3
Detroit	587	519	565	5	2	2
Houston	483	543	810	5	2	2
Las Vegas	.	753	797	.	2	2
Los Angeles	524	742	1,233	4	1	2
Louisville	477	453	527	4	2	2
Memphis	525	463	438	5	2	2
Miami	467	562	1,038	4	1	2
Minneapolis	493	641	753	5	2	1
Nashville	489	483	695	5	2	2
New Orleans	472	528	633	5	1	2
New York City	966	968	1,424	4	2	1
Philadelphia	472	544	767	6	2	1
Phoenix	350	527	796	4	2	2
Pittsburgh	562	581	635	5	2	1
Portland	423	514	575	5	2	2
Salt Lake City	399	449	649	4	2	2
San Diego	365	552	738	5	1	1
San Francisco	495	766	1,325	4	2	1
Seattle	430	588	748	3	1	1
St. Louis	517	466	504	4	2	1
Tampa	354	415	596	5	2	1
Washington D.C.	696	742	1,056	6	1	1

Note: The table shows the median unit rental prices in 2006 dollars and the modal number of rooms (fourth column) or bedrooms (fifth and sixth column) in each of three periods.

Table 4: Sale: Real Median Price vs Modal Size

	Sale					
	Median Price (2006 dollars)			Modal Size		
	1890-1939	1940-1969	1970-2006	1890-1939	1940-1969	1970-2006
City						
Atlanta	76,113	98,014	169,386	6	3	3
Baltimore	50,018	73,507	163,062	6	3	3
Boston	80,168	103,301	267,727	6	3	3
Charleston	50,799	79,044	149,296	6	3	3
Chicago	113,004	139,472	230,137	6	3	3
Cincinnati	83,229	105,660	155,431	6	3	3
Cleveland	93,142	125,581	169,413	6	3	3
Dallas	66,150	128,906	217,474	5	3	3
Detroit	85,282	97,364	140,371	8	3	3
Houston	63,113	98,134	181,605	5	3	3
Las Vegas	.	114,967	173,419	.	3	3
Los Angeles	79,800	180,000	423,233	6	3	3
Louisville	61,786	78,952	128,342	5	3	3
Memphis	68,942	81,909	153,008	5	3	3
Miami	67,575	108,635	194,065	5	3	3
Minneapolis	55,707	96,338	180,382	5	3	3
Nashville	57,232	81,017	166,660	5	3	3
New Orleans	69,919	102,093	159,138	5	3	3
New York City	161,448	174,798	323,917	6	3	3
Philadelphia	62,483	91,346	190,837	6	3	3
Phoenix	48,301	90,428	176,093	5	3	3
Pittsburgh	88,576	105,510	146,808	6	3	3
Portland	54,323	84,691	151,807	5	3	3
Salt Lake City	52,646	100,392	166,576	5	3	3
San Diego	54,359	103,125	302,846	5	3	3
San Francisco	83,899	148,780	448,122	5	3	3
Seattle	50,515	105,014	239,082	5	3	3
St. Louis	73,500	82,994	142,179	6	3	3
Tampa	44,722	69,131	137,553	5	2	3
Washington D.C.	108,000	140,208	265,115	6	3	3

Note: The table shows the median housing prices in 2006 dollars and the modal number of rooms (fourth column) or bedrooms (fifth and sixth column) in each of three periods.

Benchmarking HHP to the Census

Figure 2 shows the distribution of rents or sales prices from HHP compared with contract rents or owner valuations from the census using IPUMS microdata samples for each year.[30] The city-year pairs were chosen to illustrate the typical cases of distributional overlap. The top four panels show sales versus owner valuations and the bottom four panels show market rents versus census contract rents. We begin with sales. The first common case is that the distribution of HHP sales aligns well with the census owner valuations, which we see in many city-year pairs. For instance panel *a* shows very close alignment for Philadelphia in 1940, a year in which the market was close to the 1938 trough. Another common case is shown for Philadelphia in 1970 in panel *b*, when our HHP sales data are shifted to the right relative to the censored census distribution (at $50,000 in 1970). Topcoding is even more of an issue in expensive coastal cities, for instance see panel *c* with San Francisco in 1970. Our data thus contain more information on the upper end of the housing market relative to the census, particularly in years with binding topcodes like 1970.

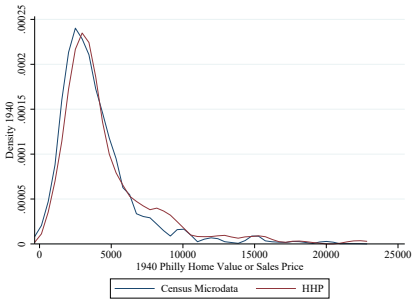
What is driving the rightward shift of our data relative to the census in cases such as Philadelphia in 1970? One explanation is limited homeowner awareness of nominal price inflation, which was greater in the 1960s relative to earlier decades. However, owner-reported values and HHP sales data are back in alignment by 2000 as seen in panel *d*, suggesting that homeowners were more aware of housing price inflation during the 1990s. Another explanation is positive selection into newspaper listing. The binned format of home value data in the census makes it hard to adjust for housing attributes; however, below we residualize the continuous measure of rents in the census by number of rooms (which is available starting in 1960) to compare with our data, also residualized by number of rooms, and find a much closer alignment in the distributions. Thus, to the extent that our sample of homes for sale is likely to be positively selected in some cities of years, controlling for size and area of the city should address a substantial portion of bias.

We similarly explore the relationship between listed rents and rents reported by households in the census in the next four panels of Figure 2. Although renters know their contract rent with more accuracy than homeowners know their home's market value, these distributions could diverge because the census rents lag market conditions, particularly during periods of high inflation. There could also again be positive selection into newspaper listings. We generally found a close alignment or a rightward shift relative to the census. We discuss two examples below.

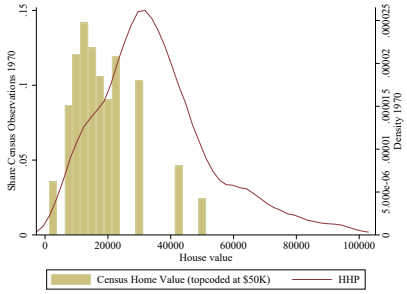
Panel *e* shows the relationship between market rents in Philadelphia in 1970 from the

[30] Steven Ruggles, Sarah Flood, Matthew Sobek, Daniel Backman, Annie Chen, Grace Cooper, Stephanie Richards, Renae Rodgers, and Megan Schouweiler. IPUMS USA: Version 15.0 [dataset]. Minneapolis, MN: IPUMS, 2024. https://doi.org/10.18128/D010.V15.0

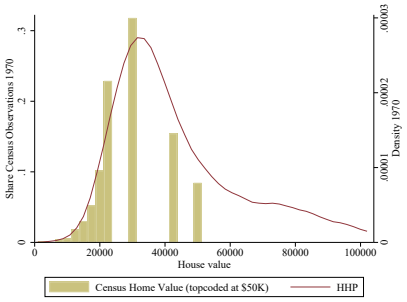
Figure 2: Census Benchmarking



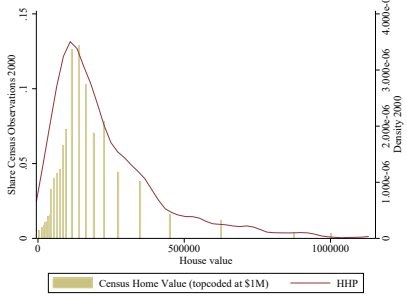
(a) Philadelphia Sales in 1940



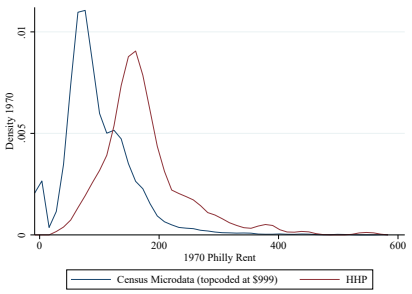
(b) Philadelphia Sales in 1970



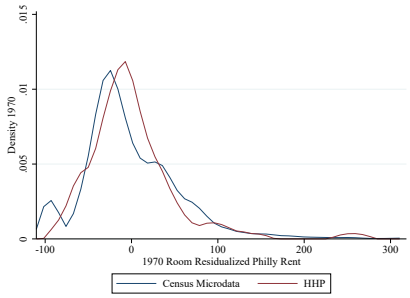
(c) San Francisco Sales in 1970



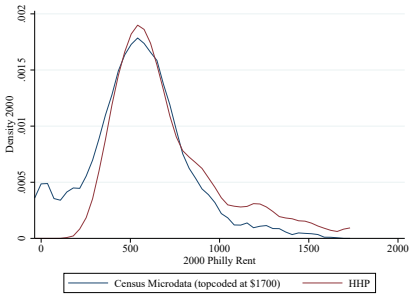
(d) Philadelphia Sales in 2000



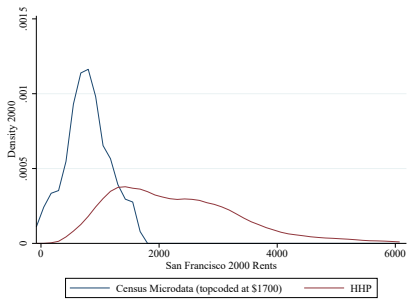
(e) Philadelphia Rents in 1970



(f) Philadelphia Residual Rents in 1970



(g) Philadelphia Rents in 2000



(h) San Francisco Rents in 2000

Note: This figure shows the distribution of census owner valuations against the corresponding year's HHP sales prices (panels a-d) and the distribution of census contract rents against the corresponding year's HHP rental prices (panels e-h).

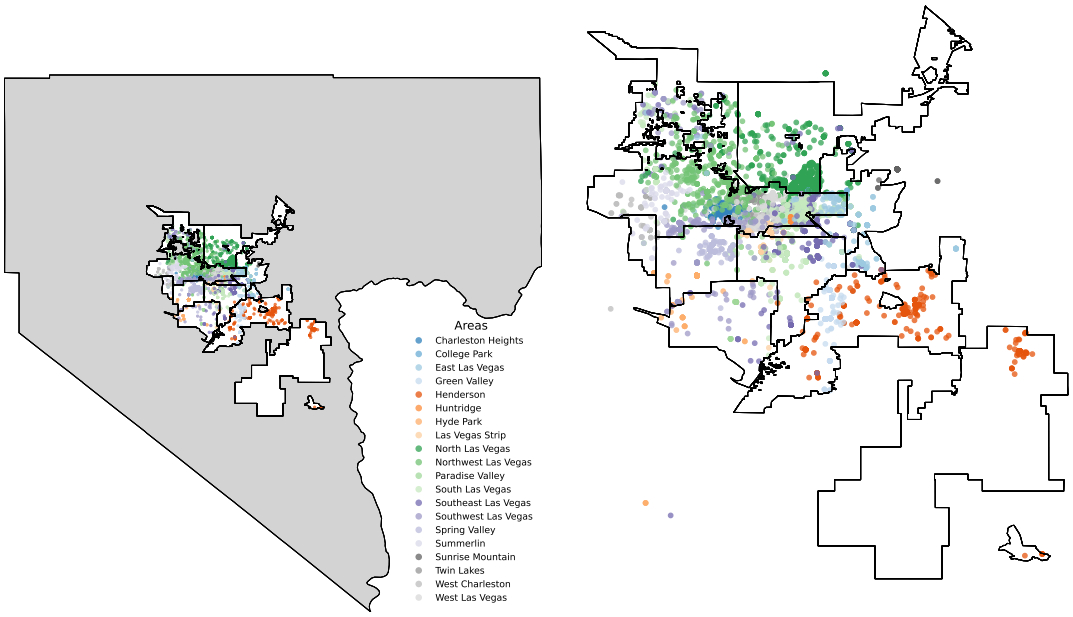
HHP data and reported values from the census. It is clear that the HHP distribution is shifted to the right relative to the census. We residualize the rents from both sources by number of rooms (first reported in the census in 1960) and repeat the density plots in panel *f*. The residualized rents show a much closer alignment, suggesting that our controls in the hedonic specification should be effective. We can also close the gap by using previous years of HHP rents, such as comparing 1968 HHP market rents with the 1970 contract rents (not shown). It is not generally possible to know how much of the gap is driven by selection versus sticky rents, as we don't know when leases were signed in the census. However, in many city-year pairs we find a close alignment between census and HHP rents even without adjusting for housing unit size, for instance see panel *g* for Philadelphia in 2000.

When we look at a city with a longstanding rent control policy, such as San Francisco in 2000, we see a major divergence in market rents from HHP and reported rents from the census. We note that the census topcoded rents at $1,700 in 2000 while a large share of market rents from our data are above $2,000. Our data in this case cover a very selected portion of the rental housing stock in the city of San Francisco, namely units that were available to rent at market prices, plus listings from expensive Bay Area counties like Marin where no rent control policy was in place. Rent control is also an issue in the 1940s due to World War II, which complicates the process of finding market-rate units. We collected listings using the same process in these years but typically ended up with fewer observations. We relaxed our rolling window specification for cities with relatively few observations during the 1940s to obtain more robust year coefficients, as discussed in Section 3.

To summarize, rent control policies create the greatest wedge between market conditions and reported rents in the census. In normal years, we found either a close correspondence or a rightward shift in the HHP data relative to the census. To the extent that these shifts are driven by sticky rents or inaccurate homeowner valuations, our data are likely more accurate. To the extent that these shifts are driven by positive selection into newspaper listing, our controls for housing unit size and area should address the most important sources of bias. Importantly, indices computed from the HHP data align very well with the FHFA and Case-Shiller indices from the 1975-2006 and 1987-2006 periods, respectively, lending credibility to our indices covering the full 20th century.

C Geocoding

Figure 3: Example of Geocoding and Area Classification, Las Vegas



(a) Clark County (b) Las Vegas-Henderson-Paradise

Note: The figure shows the geographic distribution HHP listings for both sales and rents over the 1948-2006 period along with the corresponding area assigned by the machine learning approach.

The geocoding process uses a random forest algorithm to create a consistent set of neighborhoods for each city using the disparate geographic information we have from the newspaper listings. A valid listing required an indication of location within the city. However, this information could be either an address, an intersection, or a neighborhood from either the listing or a column heading such as "West Philadelphia." For some southern cities such as New Orleans and prior to the Fair Housing Act, a common column heading was "Colored" or similar to indicate neighborhoods were open to African Americans. We took whatever information was listed in newspapers, so our "area" definitions are not necessarily anchored to an exact geographic region. "Downtown" or cardinal directions are also common.

We chose twenty areas so that identification comes from a large enough set of listings, given our relatively small samples in each year (listings can also have a "missing" area designation). The top twenty areas are based on the entire 116 year period for each city, so in early years most cities do not yet span all twenty neighborhoods. For instance, New York City has twenty areas over the whole sample while Salt Lake City has ten in 1890;

many listings were also assigned to the missing category in early years.

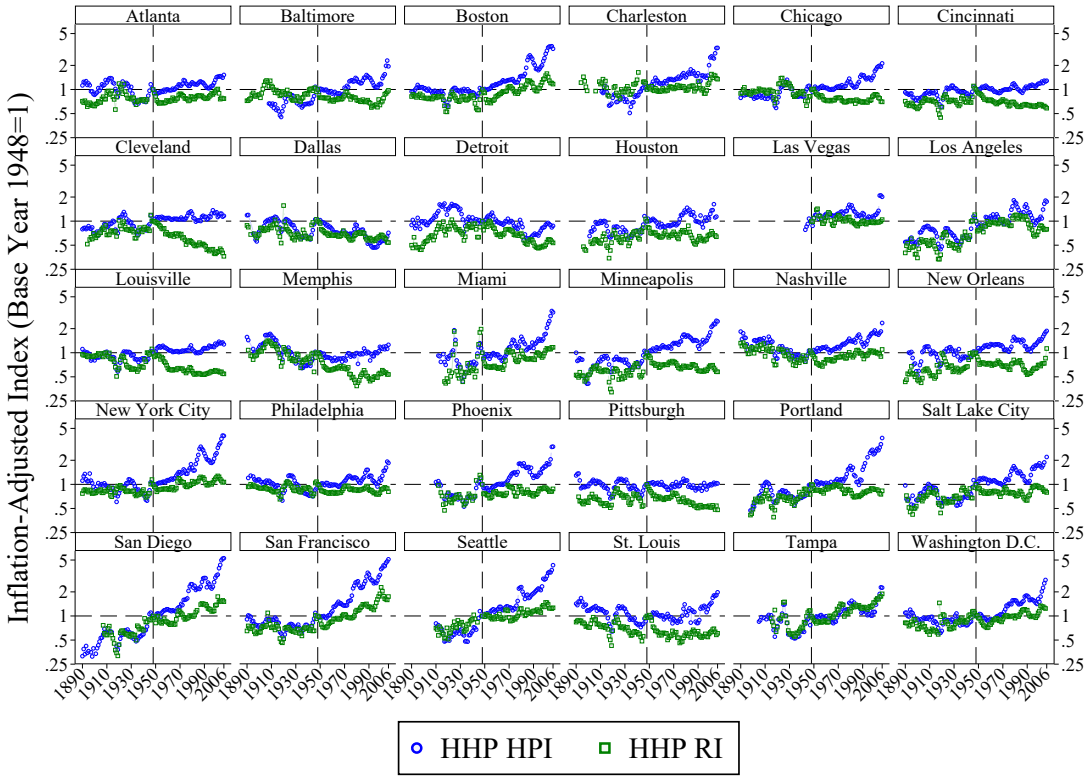
Our process is as follows: upon receiving the digitized listings, we first formed an address or general location to the best of our ability using all available information. For instance, we would combine a street address from the listing with a neighborhood from the newspaper heading. In some cases the most detailed geographic information we could get was a quadrant, for example southwest Chicago. We next ran the address or general location through Open Street Map and Google Maps to get a latitude and longitude. There are two types of inputs. In the first case, we had a latitude and longitude along with an area from the newspaper. In the second case, we had only an area, and the geocoder is returning the centroid of some area or neighborhood. In our experience, Google Maps handles intersections better (Open Street Map returns a location to intersections only if there is a current bus stop there) while Open Street Map was better for finding the centroid of the correct neighborhood when we did not have an address or intersection.

We then took observations from the case where we had both a neighborhood and a latitude and longitude from an address or intersection to train our random forest algorithm to generate the set of consistent areas. The areas were chosen to be the top twenty most frequently occurring in the data for each city. We input the coordinates, the price (listing price or capitalized rent), the total rooms, and the segment (rent or sales) to predict neighborhood. We use this model to add the neighborhood to observations without one (for instance, only an address). For observations that had only an area but no other information, the algorithm places them in the listed area if it is in the top twenty and in the most similar neighborhood according to the algorithm if not.

Figure 3 shows a representative example of the geocoding and classification of listings into twenty areas. These twenty areas include neighborhoods, cardinal directions within Las Vegas, and surrounding cities within the Clark County/Las Vegas-Henderson Paradise MSA.

D Supplemental Results

Figure 4: HHP 30-City Real HPI and RI by City, 1890-2006

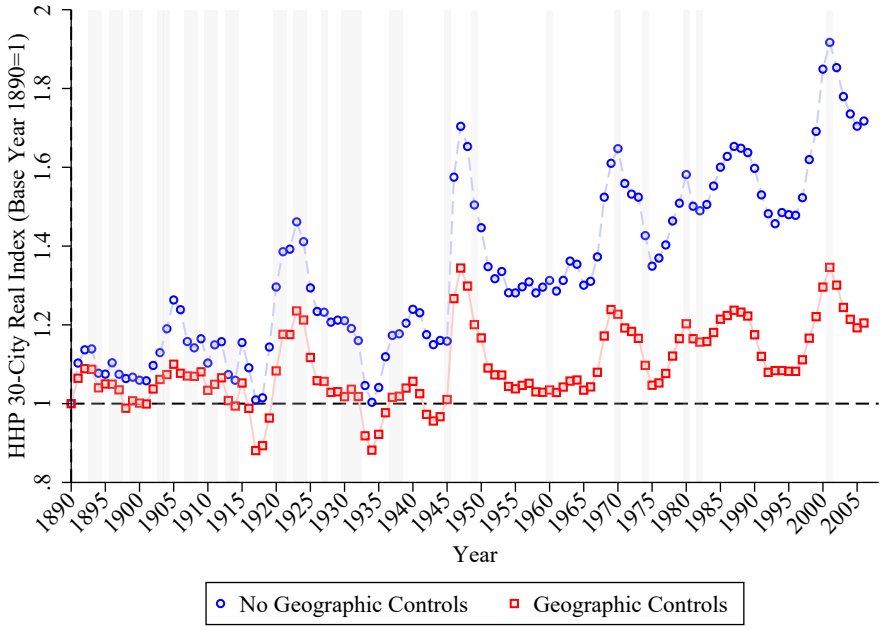


Note: This figure shows the baseline rental and sales price indices by city in real terms and with a base year of 1948.

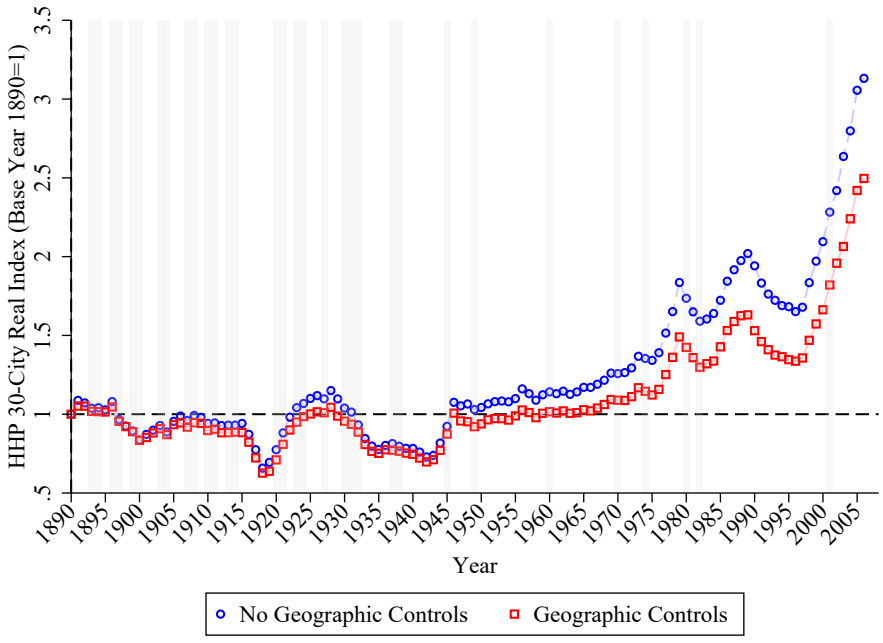
Here we present supplemental results. Figure 4 shows the HHP rental and sales series for each city with a base year of 1948. Figure 5 shows the national housing sales price indices with and without adjustments for area. In Figure 6 we provide a comparison of our rental and housing price indices with and without rolling windows. The "No Rolling Window" specification is an all-in-one regression, pooling data from all years. This means we impose fixed price differentials – across areas and property sizes, for example – over time. While differences are small in the sales segment, there are some substantial differences across rental specifications. The all-in-one specification implies significantly more cumulative inflation than any of the rolling window specifications. However, all three rolling window specifications (2, 3, and 5 year) find similar levels of rental price inflation, namely that levels in 1890 and 2006 were similar.

Figure 7 presents for all 30 cities the HHP inflation-adjusted rental price indices from 1914 to 2006. The red series, where included, is the BLS RoPR series for that city. In addition to very different trajectories in some cities, such as Portland and Cincinnati, the coverage of the RoPR series is much less detailed. Figures 8 and 9 present equivalent city-level indices for sales prices, comparing HHP indices against firstly FHFA city-level indices (from 1975) and secondly the S&P/Case-Shiller index from 1987. There is generally a remarkable degree of similarity in price trends across series. This is most clear for New York and Miami across HHP and Case-Shiller and for Phoenix and Tampa across the HHP and the FHFA series.

Figure 5: HHP 30-City Real Indices by Geography Control, 1890-2006



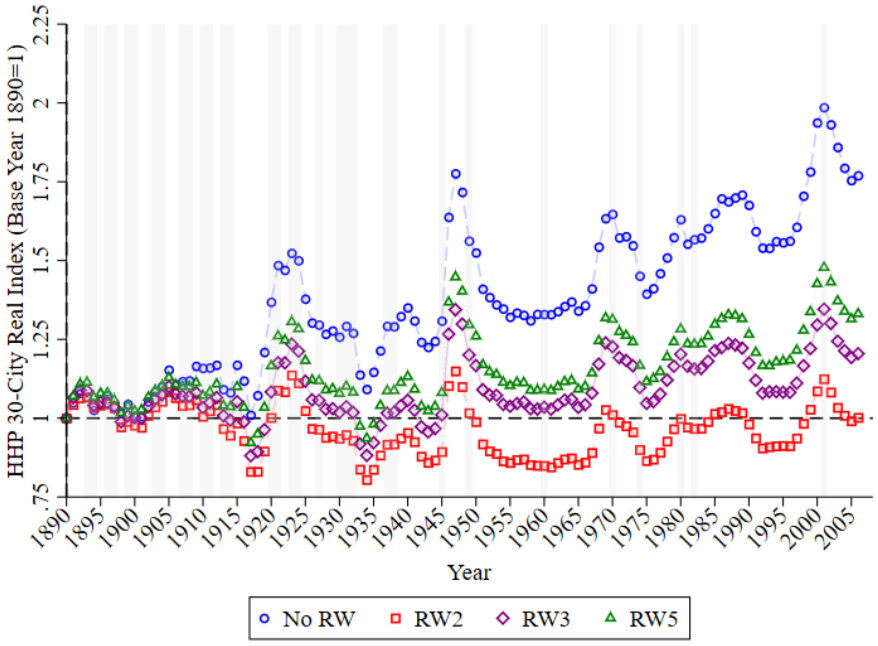
(a) Rent



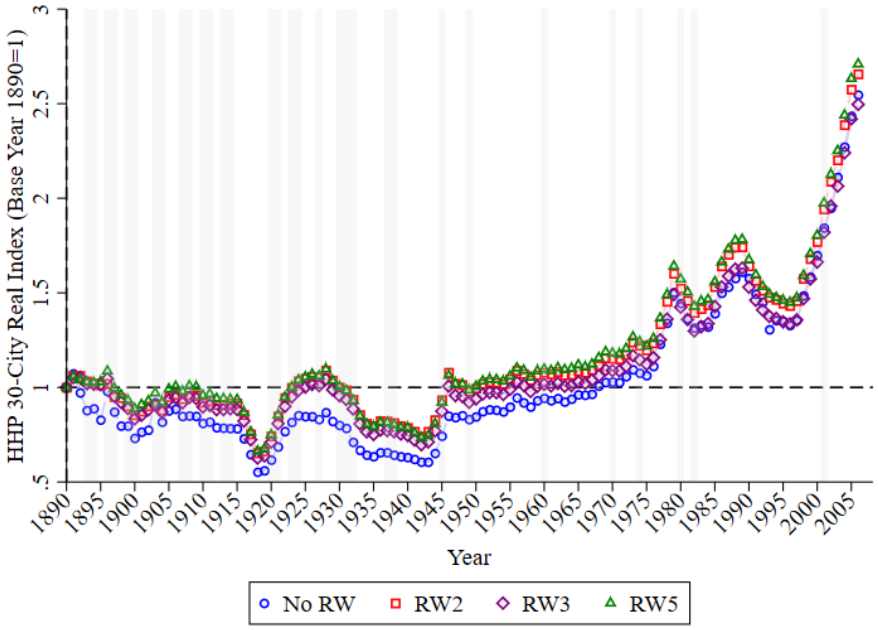
(b) Sales

Note: This figure shows the baseline real HHP rental series in panel (a) and sales series in panel (b) with and without the control for area.

Figure 6: HHP 30-City Real Indices by Rolling Window Size, 1890-2006



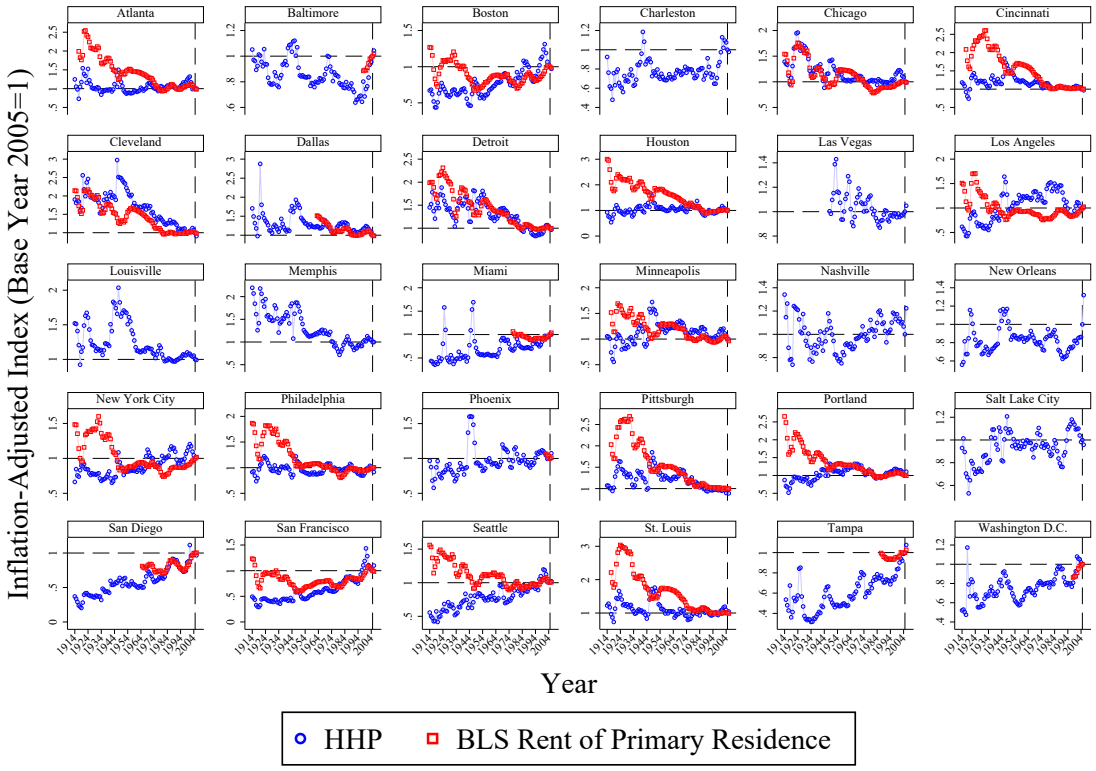
(a) Rent



(b) Sales

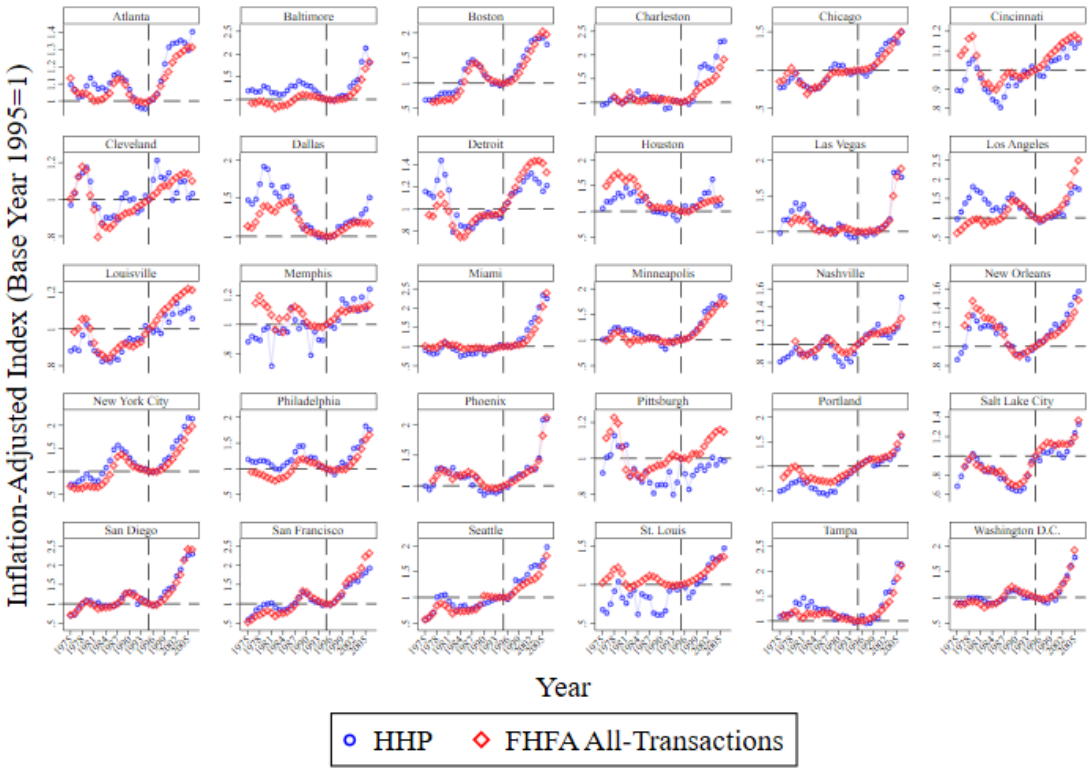
Note: This figure shows the baseline real HHP rental series in panel (a) and sales series in panel (b) with various rolling window specifications. The "No RW" specification is an all-in-one regression with data pooled across all years in the sample.

Figure 7: Comparison to BLS Real Rent Indices, 1890-2006



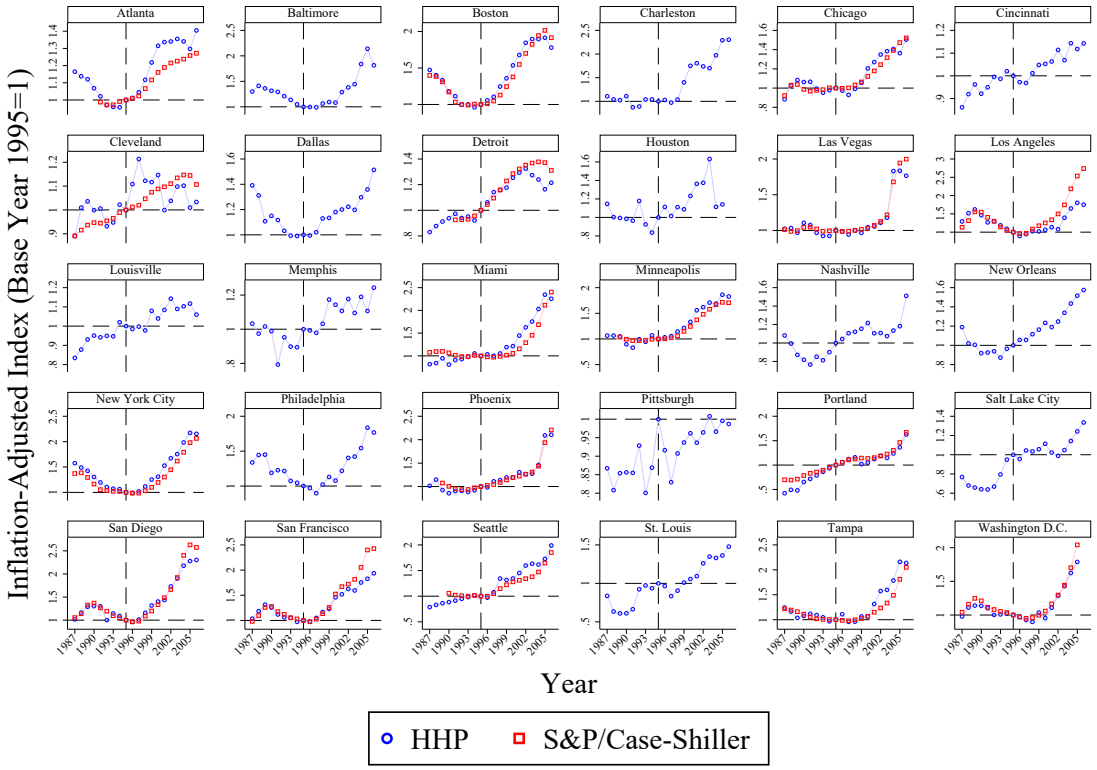
Note: This figure shows the comparison between the baseline HHP rental series for each sample city against the BLS Rent of Primary Residence series for the corresponding MSA (when available) with a base year of 2005. The MSA-level series were accessed from FRED at the Federal Reserve Bank of St. Louis, for instance the New York series was obtained from U.S. Bureau of Labor Statistics, Consumer Price Index for All Urban Consumers: Rent of Primary Residence in New York-Newark-Jersey City, NY-NJ-PA (CBSA) [CUURA101SEHA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/CUURA101SEHA.

Figure 8: Benchmarking Against FHFA Real House Price Indices, 1975-2006



Note: This figure shows the comparison between the baseline HHP city sales series and the FHFA All-Transactions Index for MSAs (base year of 1975). These data were accessed from https://www.fhfa.gov/data/hpi/datasets.

Figure 9: Benchmarking Against S&P/Case-Shiller Real Home Price Indices, 1987-2006



Note: This figure shows the comparison between the baseline HHP sales series for each sample city against the S&P Case-Shiller series for the corresponding MSA (when available) with a base year of 1987. The S&P Case-Shiller series were accessed from FRED at the Federal Reserve Bank of St. Louis; for instance the S&P Dow Jones Indices LLC, S&P CoreLogic Case-Shiller GA-Atlanta Home Price Index was accessed from https://fred.stlouisfed.org/series/ATXRNSA.