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

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**Abstract**

We construct the first market price indices for both rented and owned housing for the U.S., at national level and for thirty cities, for the period 1890-2006 at annual frequency. Our new indices use hedonic methods and a dataset of over 2.7 million newly digitized real estate newspaper listings. The resulting indices, which overcome many of the limitations of existing sources on U.S. housing prices, are used to document several new facts about housing markets in the twentieth century. First, we show that there has been greater growth in housing prices than previously understood, with home price growth was in excess of inflation in the 1920s, 1950s, 1970s, and 1990s. Meanwhile, we document a largely flat trend in real market rents. Second, the capital gain associated with housing ownership has exhibited remarkable heterogeneity across cities but was close to zero nationally before 1945. Finally, we explore why housing prices have increased unevenly across U.S. history.

**Keywords**: Housing prices; rental indices; hedonic analysis; housing markets.
**JEL codes**: E3, N1, O18, R3

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## 1 Introduction

Housing is central to economics. It is both a key service – the largest single component of consumer expenditure in the United States – and an important asset, with real estate the largest component on 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. This paper introduces new price indices for rented and owned housing in the United States going back to 1890 and uses them to establish new facts about housing markets over the twentieth century.

No annual, quality-adjusted price series for market rents exists for U.S. cities before 2000. Scholars interested in rental price levels have used surveys from the Bureau of Labor Statistics, which have been undertaken since 1914, or the census, which has asked about contract rents since 1930. Scholars interested in owned housing prices have primarily relied on the pioneering work of Robert Shiller, who spliced together several distinct data sources to obtain a national housing sales price series beginning in 1890 (Shiller, 2015). City-specific indices are not available until 1975 through the Federal Housing Finance Agency (FHFA). To date, most geocodable housing microdata beyond what was collected by the Census Bureau remains proprietary and begins in the 1990s (e.g. CoreLogic data). Economists thus know relatively little about how the market price of rented and owned housing has evolved in particular cities over the long run.

This paper introduces a dataset from the Historical Prices in Housing Project (HiPHoP) that constructs new price series for both rented and owned housing constructed from archival newspaper real estate sections for thirty cities covering the period 1890-2006. These series rely on over 2.7 million manually digitized real estate listing for both owned and rented housing that include a listed price as well as measures of size, type and location within the city. Using standard hedonic methods, we use this dataset to construct new housing price indices for both the rented and owned segments for 30 cities across the US, back to 1890, and weight to give national indices. These series are unique because they are constructed consistently across the period and reflect market conditions in each year.

The HiPHoP indices diverge from price trajectories reported in existing series in key ways. The first part of the analysis aims to carefully benchmark the HiPHoP series to widely used sources of information on U.S. housing prices and understand points of (dis)-agreement. 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 is likely to smooth market fluctuations by design but may also have missed significant components of prices increases over time, until methodological revisions in the 1980s. Indeed, unlike the ROPR series, we find no evidence that real rents fell over the 20th century; rather, we find that rental prices have been largely stable, rising and falling within a fairly narrow band. Adjusting for inflation, rental prices in 2006 were roughly 15 percent higher than they had been in 1890. Our series substantially agree with adjustments proposed to the BLS rental series by Gordon and van Goethem (2007) and Crone et al. (2010) that have been adopted by economists. If rent – and rent equivalent – increased by 3.5% per year rather than 2.6%, as measured, where housing has been roughly one quarter of the consumption basket over the last century, then overall inflation may have been understated by 0.2 percentage points per year.

For owned housing, the HiPHoP series aligns well with the Case-Shiller-Weiss and FHFA series at both the national and city level, particularly after 1980. 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 survey for the 1890-1934 period and the use of truncated loan data for the 1953-1975 period (Fishback & Kollmann, 2014; Greenlees, 1982). We find evidence of a sizeable interwar housing cycle that is not present in Shiller's series, with housing prices booming in the 1920s and cratering in the 1930s. We also document significant housing price adjustments in the 1890s and again in the 1910s. In addition, we find that housing prices began increasing in real terms by the late 1960s, similar to the census and in contrast to the Shiller index, which reports relatively little housing price growth between 1950 and 1995.

Thirdly, we examine city-level and regional differences in capital gains. For the average city/year in our period, we find a capital gain of just below 1% per year. However, this varies substantially by period, with little or negative capital gains in the 1890-1929 and 1930-1945 periods, as well as by region. Gains in the 1946-1980 period (1.5% per year) are not far off in magnitude those witnessed in the period 1980-2006 (2.3%). However, all these figures do not adjust for maintenance and depreciation. Notwithstanding the differences by period, an overall capital gain to housing of 1% per year may at best have offset such costs.

Lastly, we examine the link between housing price increases and supply constraints, in the spirit of Saiz (2010). Land constraints are positively, if noisily, linked to gains throughout, including in the 1930-1945 period, something at odds with the hypothesis that geographical constraints would become more binding as aggregate population grew. There is greater evidence that regulatory constraints – as measured at the turn of the millennium – have become a more important driver of across-city differences in price growth. This suggests deeper roots of such regulations, consistent with the hypothesis of Fischel (2015) and others that land-use regulations are in part driven by price growth.

The rest of the paper is structured as follows. The next section reviews existing sources and data on housing prices in the US over the twentieth century, while Section 3 describes the collation of our dataset of listings. Section 4 outlines both the compilation of our new housing price indices and presents analysis of how they compare with existing series. The following four parts of the paper – Sections 5-8 – present our four stylised facts, 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 (see, for example, 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 MACROHIST database for the U.S. (Jordà et al., 2019).

Importantly, the BLS surveys were designed to measure the increase in rents for a rotating panel of rental units. However, existing scholarship has taken issue with the apparent steady downward trend in real rental prices in the postwar era, attributing the apparent trend 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-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). The challenges of accurately measuring rent were known to officials throughout: Humes and 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.

This divergence between the CPI rental series and market rents will be greater if conditions are changing rapidly or if there is substantial new construction in a particular metropolitan area. The methodology employed by the BLS has undergone constant revision over the past century, particularly in response to criticisms that the rental component of the CPI was systematically downward biased in the decades after World War II (Crone et al., 2010). We discuss these issues in more detail in Section 6, where we examine the implications of the difference between our national rental and to the BLS ROPR series 1914-2006.

The other source for 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 and Raphael (2004)). As we discuss in the next section, census housing variables are both binned and topcoded in many later years. 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 sale 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 long 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 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 **??**.

Beginning in 1975, the FHFA provides MSA-level sales price indices, and the CoreLogic 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 the CoreLogic data can be purchased by researchers only from the 1990s onwards. An important aspect of the HiPHoP dataset for economics is that the underlying microdata will be made available to the profession. We discuss this dataset in detail in the next section.

## 3 HiPHoP Newspaper Data

The housing price data in this paper was collected from the real estate sections of city newspapers from the years 1890 to 2006 as part of the Historical Prices in Housing Project (HiPHoP). 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 and Jacobs (1961), Shiller (2015), and Fetter (2016) did so in their work covering multiple cities at various points in the twentieth century. However, the HiPHoP dataset is much broader in scope and, unlike Rees-Jacob and Shiller, adjusts for the mix of properties by 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 and 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 which is infeasible for multiple cities across multiple decades and relevant only for 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 HiPHoP dataset contains 30 cities, which were chosen to obtain a diverse sample in terms of geography and economic trajectory over the twentieth 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 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, and (3) an indication of location within the city. The location could be either an address, an intersection, or an area. See Appendix B Figure **??** for an illustration of acceptable listings. 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. The different forms of location information were aggregated into a set of approximately twenty areas for each city using a simple machine learning method based on latitude, longitude, and housing attributes. See Appendix C for details on this process.

For most cities, a substantial volume of listings is available in most years from the 1910s. Exceptions include post-WW2 rentals, which were scarce due to federal rent controls, and the earliest two decades. Where listings were scarce, we included a city-year-segment triad in the dataset if we could obtain at least thirty valid listings. As a result, while most major cities start in 1890, some cities enter the dataset later; while Miami and Phoenix start in 1920, the latest is Las Vegas, where housing market listings existed in sufficient numbers only by 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. The final dataset contains just over 2.7 million observations.[1]

We thus 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 sale prices, particularly across business cycles. Little empirical 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).

[1]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, before running into resource constraints. New York has the largest dataset, in part reflecting its large weight in the national sample, especially earlier and especially in rental markets, but also reflecting other research being undertaken by authors of this paper on sale and rental housing prices in that city.

Table 1: Sample 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 | 1901 |
| Las Vegas | Review Journal | 1948 | 1943 |
| Los Angeles | Times | 1890 | 1890 |
| Louisville | Courier-Journal | 1890 | 1890 |
| Memphis | Commercial Appeal | 1891 | 1890 |
| Miami | Herald / News | 1914 | 1912 |
| Minneapolis | Star Tribune | 1890 | 1890 |
| Nashville | Tennessean | 1890 | 1890 |
| New Orleans | Times-Picayune | 1890 | 1893 |
| New York | Times | 1890 | 1890 |
| Philadelphia | Inquirer | 1891 | 1891 |
| Phoenix | Arizona Republican | 1912 | 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 | 1890 | 1897 |
| 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.*

We argue our indices are useful for at least three reasons in spite of 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 does not contain transaction prices either, the self-reported values have been widely used. In Appendix B, we benchmark individual city-year pairs of the HiPHoP and census data, showing common cases of distributional overlap.

To summarize, we typically find either a close alignment of the distributions or a rightward shift in the HiPHoP data relative to the census. To the extent that these rightward shifts are driven by sticky rents or inaccurate homeowner valuations in the Census, our data is likely a more accurate snapshot of the housing market in that year. It is also possible that there was positive selection into listings in some city-year pairs, 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. We do not observe a systematic relationship between shifts and the business cycle. Instead, 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. Additional discussion of 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, Case-Shiller, and the BLS for the final decades of the sample, lending credence to the earlier decades of the HiPHoP dataset. We discuss index benchmarking in the next section. A final reason our indices are useful is that we simply do not have annual city-level housing price series for owned 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 examining a range of questions.

## 4 Price Index Construction and Benchmarking

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 benchmark them to existing sources of information on both national and city-level housing markets for the United States.

In contemporary settings, scholars are able to observe the same property more than once, allowing the construction of "repeat sales" indices which 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 and subject to repeated revisions (Nagaraja et al., 2014). A repeat sale index is not possible, for either sales or rentals, using newspaper listings, as the full address is not required for listing.

Instead, we use a hedonic model with controls for both observed and unobserved housing unit attributes, in line with current recommended practice by, for example, the IMF (Silver, 2016). Supporting this choice of method, our indices align quite closely with existing sources for the post-1990 period despite differences in methodology, and our series diverge in earlier decades precisely where scholars have criticized the underlying data or approaches in either the BLS or Shiller series. Shen and Ross (2021) suggest that one risk of hedonic methods is that they may be biased upwards, due to unobserved quality changes. These concerns are even more important over the long run, so for that reason, we use a rolling windows method, as described below.

We use a "rolling window" regression approach to control for unobserved quality changes (Silver, 2016). An all-in-one regression, where all years of the dataset are combined, imposes a fixed vector of coefficients on size, type and location variables. However, the relative price of size or locations is likely to change substantially over time. A rolling window, of two, three or five years, allows changes in coefficients for size, type and location over time, better isolating 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 generally find large differences.

We build our hedonic price indices using listed rent or sales price as the outcome of interest. In both sale and rental specifications, the regressors include measures of size, type and location within the MSA from the newspaper listing, as well as the year of listing, 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. 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, especially after World War 2, monthly rentals dominate. Weekly were more likely to occur in the 1930s than in other decades, perhaps reflecting income uncertainty during the Great Depression, while annuals were most common in the 1890s (and concentrated in particular cities).[2]

Each listing includes at least one measure of the following measures of size: total rooms, bedrooms, bathrooms, and number of storeys. In general, total rooms is used earlier and bedrooms used later; number of storeys was a common measure of size for properties for sale in 1890s New York. 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. For the within-MSA area measure, we constructed a set of twenty areas for each city using the address, intersection, and neighborhood or region information from the newspaper listings and a simple machine learning classification algorithm. Details on this process can be found in Appendix C.

The hedonic pricing model is thus the following regression equation, where we create an index for one city at a time and aggregate by population share to create a national index. As above, controls include location within the city, size (rooms, bedrooms, bathrooms,

[2]In particular, 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, where available. With some specific adjustments where necessary, anything less than 60% of the 5th percentile of monthly rents was classed as weekly; anything more than 5 times the 95th percentile was classed as annual; and anything between the 5th and 95th percentile was classed as monthly. This reduced the number of rental listings with unknown frequency to just 33,000.

storeys), dwelling type (house or apartment) and rental payment frequency.

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

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). The advantage of this approach is that we are not making a strong assumption about the unobserved quality of housing remaining unchanged over a century as we would be if we ran a single regression to obtain year coefficients for the entire period. As a result, we generally find less housing price appreciation if we use rolling windows versus an "all-in-one" approach in which year coefficients are obtained from a single regression, particularly for the rental price index. See Appendix D Figure 10 for a comparison of our rental and housing price indices with and without rolling windows. In Appendix D, we also provide housing price indices with and without adjustments for area. Controlling for area also generally reduces the amount of estimated housing price growth.

In all cases, we transform (exponentiate) and rebase (to a base year) the year coefficients from the above regression to obtain our indices.[3] The resulting series can be interpreted as the percentage change relative to the chosen base year.

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

We begin our benchmarking exercise for rents chronologically, with the Rees and Jacobs (1961) series based on the unweighted, unadjusted average rental price from six city newspapers that covers the 1890-1914 period in Figure 1a.[4] The series align surprisingly well given the larger sample and additional controls in the HiPHoP dataset. Both sources reveal similar rental price cycles between 1890 and 1914, with prices starting and ending around the same level.

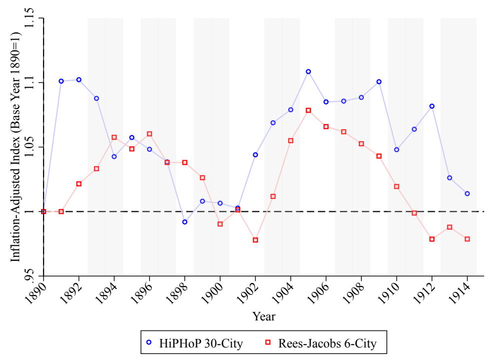
We next compare our market rental index with the BLS "rent of primary residence" (RoPR) series, which has been collected since 1914.[5] This is not a straightforward exercise, as the BLS series is not intended to capture market conditions. We are nonetheless interested in this comparison since market conditions should converge on average rents over the long run, and the overall trajectory of rental prices is both in dispute and of interest.

[3]In the event of missing years, we used the previous year's coefficient in the index. If the missing year is at the start or end of the series, we assign a value of zero that city in that year. There are relatively few missing years, see Appendix B Table 4.

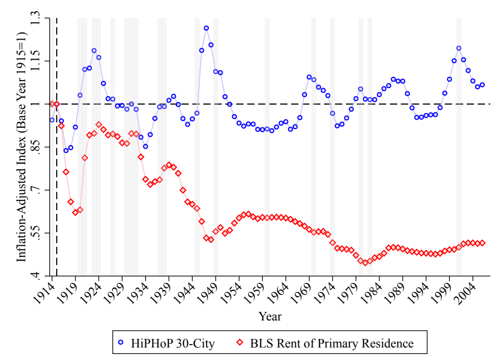
[4]Tables 22 and 32, in Chapter 4 of Rees and Jacobs (1961) provide estimates of market rent indices for six cities and a national index based on the unweighted average of their levels

[5]These data were sourced from the FRED database, with the ultimate source being quarterly reports on the Consumer Price Index for the urban U.S.

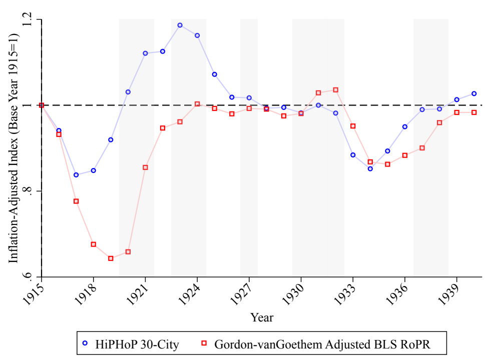
Figure 1: Benchmarking Against Rees-Jacobs and the BLS, 1890-2006



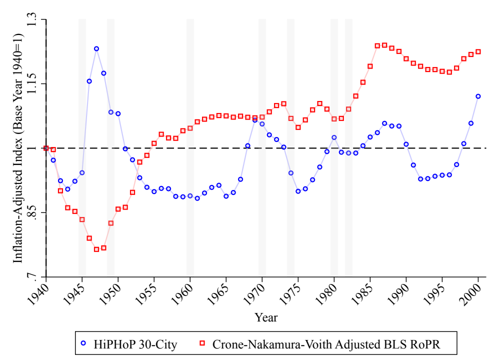

(a) Rees-Jacobs, 1890-1914




(b) BLS RoPR, 1914-2006




(c) Gordon-vanGoethem, 1915-1939




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

Note: *This figure shows the HiPHoP national series against the Rees-Jacobs series in (a), the BLS Rent of Primary Residence in (b), the adjusted BLS Rent of Primary Residence series proposed by Gordon and van Goethem (2007) in (c), and the adjusted BLS Rent of Primary Residence series proposed by Crone et al. (2010) in (d).*

Figure 1b plots the BLS rent of primary residence series against the HiPHoP market rents series. The HiPHoP data indicates that rental prices fluctuated within a remarkably narrow band between 1914 and 2006, with real price levels in 2006 at most 15 percent higher or lower than those in 1914. All rental booms from the early 1950s to the 1ate 1990s were eventually followed by declines in the rental price level, keeping the overall trend relatively flat.

This story of stable real rents is, of course, not what the BLS reports, with rental price levels appearing to fall by nearly half between 1914 and 2006. We thus also compare our series to the adjusted BLS series proposed by Gordon and van Goethem (2007) for 1915-1939 and Crone et al. (2010) for 1940-1995 in Figures 1c and 1d, respectively. We find a much closer agreement with the former series, with both finding 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 would not appear immediately in the BLS by construction. The two series do converge on a similar level of growth, however, with rental prices between 15 and 20 percent higher in 2006 relative to 1940.

There is no annual market rental series against which we can benchmark our estimates over the twentieth century. Yet our finding of real rental price levels remaining relatively stable over the twentieth century accords with the most influential proposed revisions to the BLS series.[6] The coverage of the two indices is also quite different. We report MSA-level comparisons, where available, in Appendix D Figure 11. Interestingly, some cities *do* exhibit falling real rental price levels in the HiPHoP data, including Detroit and Cleveland. In other cases, the fall in rents in the BLS series is not evident in the HiPHoP data.

We next benchmark the HiPHoP series for sale prices to the index proposed by Shiller (2015), separating the index according to the underlying data source.[7] One of the main findings about housing discussed in *Irrational Exuberance* is that real housing prices have only increased twice since 1890, first after World War II and second since about 1997. A second finding is the lack of an interwar housing cycle. We revisit both of these findings using the HiPHoP dataset.

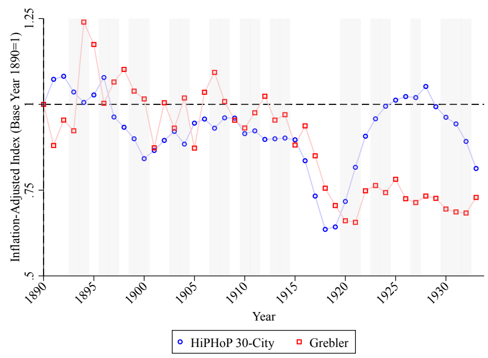
We begin with the Grebler et al. (1956) portion of the index from 1890-1934 in Figure 2a. While our series align to a large degree in before World War I, the HiPHoP series reports a strikingly different housing price cycle between the wars relative to the 1934 survey used by Grebler et al. (1956). This 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 and Scherbina (2013)'s study of New York City, and Fishback and Kollmann (2014)'s study of New Deal reports. Overall we find that prices rose by 39% between 1920 and 1929 and then fell by 23% by 1935. Prices did not recover to their 1928 peak until 1946.

Figure 2 shows the relationship between the HiPHoP and Shiller series for the next

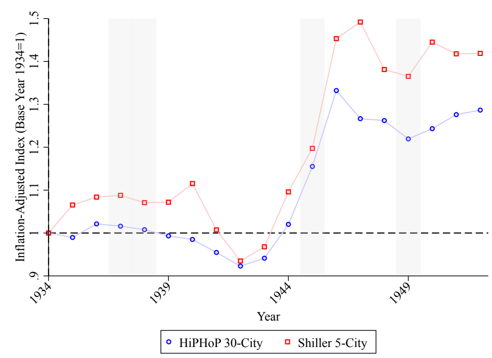
[6] Both the Gordon and van Goethem (2007) for 1915-1939 and Crone et al. (2010) for 1940-1995 have been incorporated into the widely-used MACROHIST database (https://www.macrohistory.net/database/) for the United States.

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

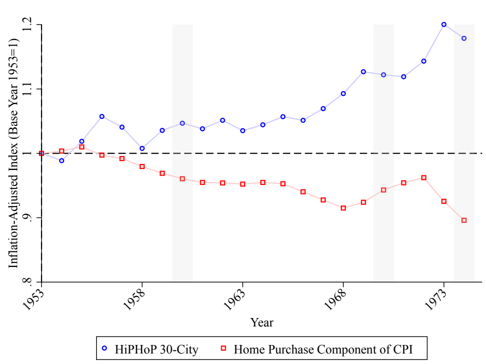
Figure 2: Benchmarking Against Components of Shiller Index, 1890-2006



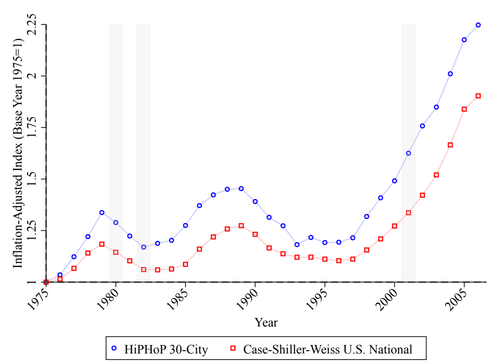

(a) Grebler, 1890-1934




(b) Shiller 5-City, 1934-1953




(c) Home Purchase Component of CPI, 1953-1975




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

portion of the latter index, which is based on a simple average of thirty 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 thirty cities instead of five. Specifically, we find that owned housing prices increased by only 28% between 1934 and 1953 as opposed to the 42% reported by Shiller.

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 percent while we find a 18 percent 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 simply was no source of better 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).[8] Roughly 50% of our sale listings across 30 cities (80,400 of 158,900 listings 1971-1979) are excluded if the FHA limits are used. Our truncated data match the Shiller index more closely. Our data thus supports the Greenlees critique and suggests housing prices began rising earlier than 1997.

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. With the exception of the very earliest years of this period, the two series match very well. Overall we find about 25 percent 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) includes appraisals before 1992, which could potentially understate housing price growth in the 1975-1991 period. The HiPHoP data also includes the entire owned housing market instead of just the single-family home market as with CSW, although the bias associated this difference is not obvious. Finally and perhaps most importantly, the HiPHoP data is limited to thirty major cities instead of the entire country. We find housing prices appreciated by 125% over the 1975-2006 period in those thirty cities compared to the 90% found in the CSW series.

To further explore the performance of most recent decades of the HiPHoP dataset, we benchmark our sample at the MSA level to both the FHFA All-Transaction and Purchase-Only home price indices (starts in 1975 at the earliest) and the S&P/Case-Shiller home price index (since 1987) in D Figures 12 and 13, respectively. The MSA-level indices reveal 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 HiPHoP and existing series for the last decades of the sample.

The HiPHoP 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 pioneering efforts of many generations of economists, statisticians and government agencies as well as providing novel informa-

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

tion on market rents and city-level housing markets. In the rest of the paper, we use the HiPHoP data to revisit several big questions about the long-term evolution of housing markets in U.S. history.

# 5 Housing and the Business Cycle

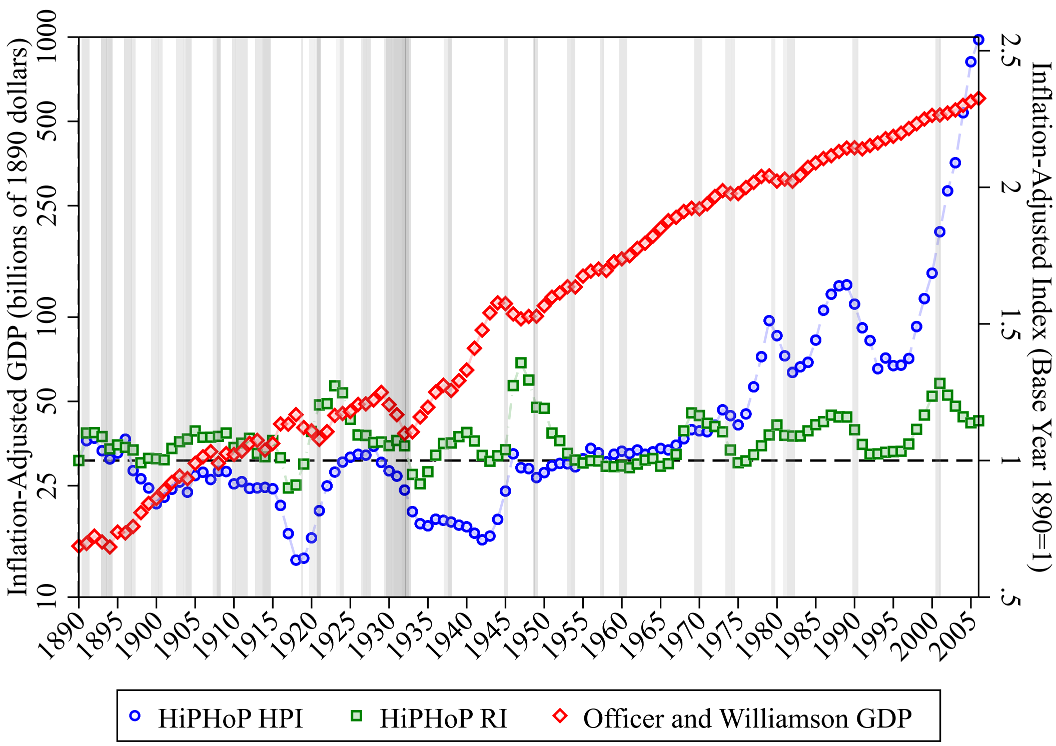



Figure 3: HiPHoP 30-City Inflation-adjusted sale and rental indices of housing prices, and GDP, 1890-2006

Is the housing cycle the business cycle, as Leamer (2015) argued?[9] 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 both evolved with GDP over the twentieth century United States. Specifically, in Figure 3, we plot our baseline national HPI and RPI against the Johnston and Williamson (2023) GDP measure, with the indexes starting at 1 in 1890 and GDP expressed in 1890 dollars.[10] Recessions are shaded in gray, with darker gray denoting sharper contractions in output.

[9]Leamer argues that the volume of housing rather than the price of housing that follows the business cycle. We borrow his phrasing here nonetheless.

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

We find that – in line with the research on 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 in housing prices move in the same direction: in 76 years out of 116 for sale prices and 65 years for rental prices. Higher frequency data and more systematic methods are likely required to identify which series led and which followed. However, our annual series extending over 12 decades suggest many interactions between the real economy and the housing sector. Only after World War 1 (1920-21) and again after World War 2 (1946-47) do we see clear evidence of an economic contraction without any 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 after the 1896 contraction or again in the early 1980s, suggesting spillover effects from the real economy to the housing sector that lasted a greater period of time. We also document three major economic downturns where the sequence runs the other way, in particular starting with a fall in real rents, followed by a fall in real prices and then in real GDP. The most obvious is the Great Depression: real rents start to fall in 1924, prices in 1927 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 and 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 economic booms of the early 1920s, late 1940s, and late 1990s – in two cases reflecting postwar scarcity – but in all three cases real rents fell within a few years to their long-run average. Compared to their base year in 1890, real rental price levels were above 10% higher for just a handful of years over the entire twentieth century. As noted above, economic downturns were associated with a fall in the rental price level, particularly in the Great Depression but 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 home ownership. For instance in the late 1920s, early 1950s, and early 2000s all saw housing prices and rental prices move in opposite directions.

The owned housing price index arguably tracks the business cycle more closely. Far from being an outlier economic event that was not associated with a boom and bust in the housing market as suggested by the Shiller index, 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. In inflation-adjusted terms, the fall is smaller (27%) due to Depression-era deflation, but – with sale prices stagnating as wider inflation returned – real prices only bottomed out in 1942, one third below their 1928 peak.

Our series also highlights two earlier price slumps in housing. The first started with prices peaking in 1892. A fall of 12% by 1894, partly offset in real terms by wider deflation, was followed by a modest recovery to 1896. After this, however, prices fell by over 20% in nominal terms, with prices in 1900 28% lower in 1900 than they had been in 1892 or 22% in inflation-adjusted terms. This aligns with broader economic conditions, with the Panics of 1893 and 1896 affecting economic and indeed political outcomes in the US.

The second pre-Depression slump in real housing prices was more pronounced, more temporary and driven by surging inflation rather than falling nominal prices. In nominal terms, housing prices had been largely flat between 1906 and 1914. With an upward creep in the price level, however, in real terms prices were about 5% lower in 1914 than in 1906. During World War I, nominal housing prices rose by almost 10%. However, wider CPI rose by almost 60% in the same period (1914-1918) meaning that, adjusting for inflation, housing prices fell by almost 30% during this period.[11] Housing prices surged 1918-1920 and continued to increase in the early years of the 1920s, even as wider price levels fell back. By 1922, housing prices had returned to 1914 levels in real terms and at their peak in 1928 they were on a par with the levels seen in the early 1890s.

In addition, the HiPHoP data also reveals a sizeable housing cycle between 1982 and 1995 (see, for example, Himmelberg et al., 2005) . Having risen 37% in inflation-adjusted terms 1971-1979, real prices then fell by 12.5% by 1982, as housing price gains did not match those in the wider economy. By 1989, however, prices had increased in real terms by almost one quarter, only to reverse those gains completely by 1993. In that year, real prices were effectively unchanged from their level a decade earlier. 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 in the sales price of housing. This episode also did not lead to a decline in housing starts, highlighting the need to consider housing volumes alongside price.

We view this as an important area for future research on the long-run evolution of U.S. housing markets. Indeed, the long-run link between economic activity more generally and housing prices – both sale and rental – is clearly a fruitful avenue for future research. Some questions and methods may require higher-frequency data, with quarterly and even monthly series at city-level a possibility given the nature of listings data. The annual series above suggest a number of important follow-on questions. These include the impact of tenure policy, in particular the shift to supporting homeownership, on housing outcomes, especially differentially across sale and rental segments. Overlapping this is the obvious difference in trend rates across the two segments since the 1970s. Both segments exhibit cyclical behaviour but in the case of sale priecs, this is around an upward, rather than stable, long-run trend, with additional supply apparently sufficient in the rental sector to offset increases in demand, at least until the 2000s. The divergence of the two series also raises topics around the financialization of housing and the role of credit.

## 6 Nominal Rental Prices and the CPI

As discussed earlier, the top-right panel of Figure 1b presents our national rent index compared to the BLS measure of rents from 1914 to 2006. Adjusting for wider inflation, it showed real rents in the BLS series fell sharply between 1914 and 1950 and fell more steadily between the mid-1950s and the early 1980s. In contrast, our real rent index shows a largely stable long-term trend, with significant cyclical behavior around that trend.

Figure 4 presents the two series in nominal terms, on a log-scale. Cumulatively over the period 1914-2006, the hiphop index of market rents rises by a factor of 23.5 compared

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

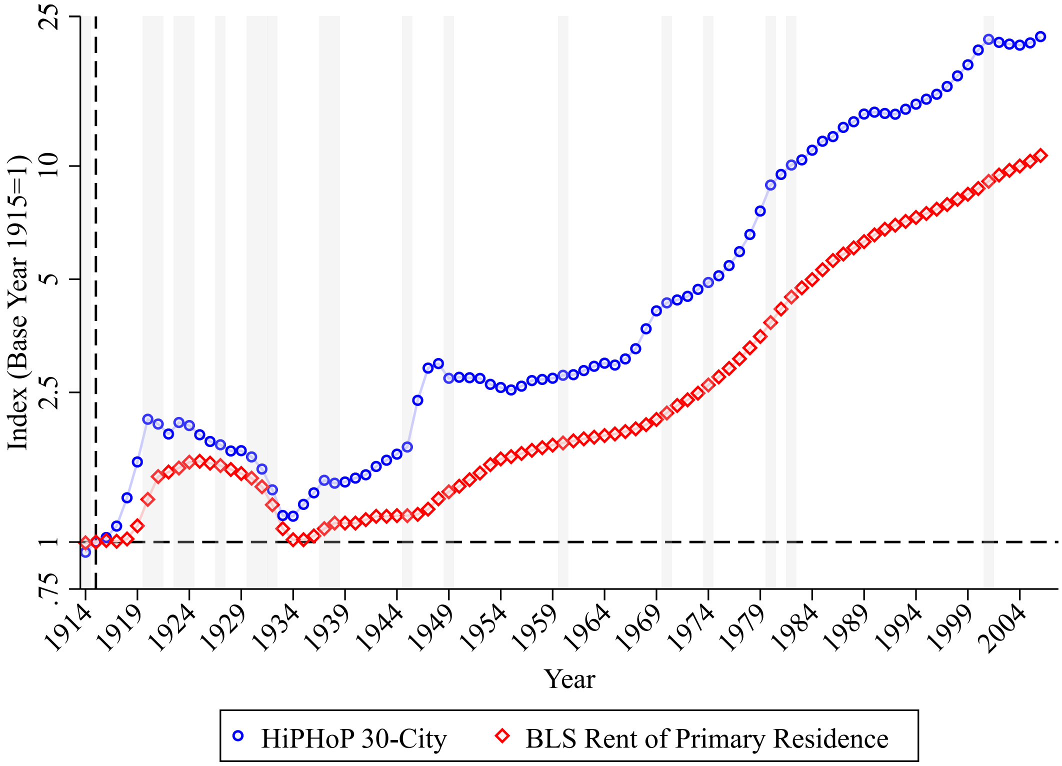



Figure 4: HiPHoP 30-City Inflation-adjusted rental index of housing prices, compared to BLS Rent of Primary Residence, 1915=1

to just 10.7 for the BLS Rent of Primary Residence (ROPR) series. For context, the CPI ex-shelter index rises by a factor of 19.4 in the same periods. In annual growth terms, our rent index is almost one percentage point greater than the existing ROPR index: 3.5% per year vs 2.6%. This would put housing inflation slightly above inflation in the wider economy (ex-shelter is 3.3% per year) rather than well below. The question, therefore, is whether rents rose roughly in line with wider prices during those nine decades, as per HiPHoP, or if – as per the ROPR series – rents rose by half as much as wider prices.

The treatment of rent, and shelter more generally including homeowners' housing services, has been the subject of much research and revision over the past century. As with housing indices more generally, the challenge is to adjust for the quality of housing, especially over the long-run. With rent indices, additional challenges come from the survey-based nature of CPIs: ultimately, the dwelling is the object of interest, rather than the household, but households respond to the surveys that inform price indices, not dwellings.

The various challenges are summarized by Crone et al. (2010). Firstly, the reporting by households of changes in rents may be unreliable. Secondly, the quality of a given dwelling will change over time. This could be downward, due to imperfect maintenance, or indeed upward through improvements made by the landlord or tenant. Thirdly, as tenants move, vacant apartments may experience a "reset" in rents to market levels (where allowed by law), a change in rents that would not be captured where the dwelling is not included in the survey under new tenants. This latter source of potential bias was relevant in particular between 1942, when the BLS changed its methodology from surveying agents and property-owners to surveying tenants by mail, and 1985, by which time the BLS had taken and revised steps to correct for vacancy bias (Crone et al., 2010). Non-response rates were as high as 30% by 1947 (Humes & Schiro, 1949). However, while the BLS rental inflation measure attempts to correct for all these factors, those corrections are not applied retrospectively.

Our series can shed insight not only in the potential extent to which rent increases may have been understated before revisions but also about which of the concerns above may be most responsible. To do this, we examine five-year changes in rents during the period. The three biggest contributors to the difference are 1914-1920, 1940-1950 and 1965-1980. Indeed, excluding the two War and postwar periods, and the 1965-1980 period, the ROPR and HiPHop measures show remarkably similar overall changes 1914-2006: an increase of 120% in the BLS ROPR series compared to 122% in the HiPHoP series.

The first two of these periods are associated not only with World Wars and their aftermaths but with significant inflation in the wider economy and with rent controls. One would expect an *a priori* difference between a series capturing open-market rents (as per HiPHoP) and one capturing average contract rents during a period that combines rent controls and high inflation. However, these differences should disappear as controls are lifted and/or as tenants moved on and the rent of a dwelling resets to market levels. In other words, while one would not expect 67% spike in market rents seen 1945-1948 to matched in the ROPR series, it is unclear why over the period 1940-1955 the ROPR would differ so substantially to a mix-adjusted measure of market rents: an increase of less than 20% compared to an increase of more than 50%.

The latter period during which the two series differ is also one of high inflation in the wider economy. While the CPI ex-shelter series had an average annual change of +2.4% 1914-1965 and +3.3% 1980-2006, the average rate of change in prices 1965-1980 was 6.3%. Combined with the two other periods during which market rents and the ROPR measures differed, and with the use of rolling-windows hedonics to control for changes in the mix of rental homes in this period, this is strongly suggestive evidence that the different path of vacant and occupied rental dwellings is at the core of differences between the published ROPR series and our measure of mix-adjusted market rents.

This "vacancy effect" resulted in a major change in 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 and Sommers (1983) of 18 months of responses October 1979-March 1981 by both existing and new tenants found that new tenants faced significantly higher inflation (18.6% annualized compared to 8.1%) and thus that a share of true inflation was unmeasured where vacant units were omitted.

This suggests an important avenue of future research on the cost and standard of living in the U.S. over the long run. In particular, if the increase in market rents – and thus imputed rents paid by homeowners, which are based on market rents – has been understated over the long run, then given the role shelter plays in the consumption basket, the long-run increase in living costs has been understated and, by extension, the increase in living standards overstated.

We close this section with a rough estimate of the potential scale of this correction, ahead of a more detailed look. Consider an economy where shelter comprises one quarter of the consumption basket and other services comprise the remaining three quarters. Using the BLS measure of rents, the price of shelter grew by 2.6% per year 1914-2006, while using the HiPHoP measure, it grew by 3.5% per year. The price of other services grew by just under 3.3% per year. A weighted price index, comprising these two broad services, with 1914=1, would take a value of 17.2 in 2006 using ROPR for shelter and 20.4 using the HiPHoP measure of market rents. In other words, the potential downward bias in CPI due to understating the increases in the cost of housing over almost a century could be as large as 0.2 percentage point: an annual growth rate in prices of 3.33% compared to 3.14% in the exercise described here.

# 7 Capital Gains across Housing Markets

In this section we revisit another debate in the literature focusing on the long-run capital gain associated with homeownership in the United States (among others, Amaral et al., 2021; Ganong & Shoag, 2017; Himmelberg et al., 2005). Economists have debated the average annual gain implied by the national Shiller index (0.7%) or the median census housing value (around 2%) over the period 1940-2000 (for example Davis et al., 2008; Davis et al., 2007). Both of these data sources have limitations, namely that the census is only available once a decade and lacks information on housing quality while the Shiller index relies on very different sources of data over time. A measure of the capital gain based on an entirely new dataset would thus be useful, as would city-specific measures that span the full twentieth century.

We compute the capital gain as a function of our baseline housing price $\text{HPI}_{c,t}$ index for city *c* and year *t* as follows:

$$H_{c,t} = \frac{\text{HPI}_{c,t} - \text{HPI}_{c,t-1}}{\text{HPI}_{c,t-1}}$$

Where $\pi_t = \frac{\text{CPI}_t - \text{CPI}_{t-1}}{\text{CPI}_{t-1}}$, this gives a formula for real capital gain, as follows:

$$h_{c,t} = \frac{1 + H_{c,t}}{1 + \pi_t} - 1$$

And where $t \in T = \{1890, 2006\}$, we define the average annual real capital gain in arithmetic, rather than geometric terms, for the purposes of looking at the average year (rather than exponential gains):

$$\bar{h}_c = \frac{1}{|T|} \sum_{t=1890}^{2006} h_{c,t}$$

Weighting by city population to aggregate to the national level and taking the arithmetic mean over the real capital gain averaged across each period, we find that inflation-adjusted owned housing prices increased by 1.41% a year on average between 1940 and

Table 2: Average Capital Gains Associated with Housing Ownership

| City | Period | | | | Full |
|---|---|---|---|---|---|
| | 1890-1929 | 1930-1945 | 1946-1980 | 1981-2006 | Time-Series |
| Atlanta | 0.02 | 0.36 | 0.87 | 0.90 | 0.52 |
| Baltimore[e] | 1.01 | 0.92 | 1.73 | 1.84 | 1.47 |
| Boston | 0.26 | -0.28 | 1.51 | 3.44 | 1.28 |
| Chicago | 1.29 | 0.07 | 0.43 | 2.25 | 1.08 |
| Charleston[f] | – | 4.39 | 1.14 | 3.94 | 2.76 |
| Cincinnati | 0.73 | -0.97 | 0.66 | 0.55 | 0.43 |
| Cleveland | 1.08 | 0.10 | 1.07 | -0.01 | 0.70 |
| Dallas | -0.14 | 0.98 | 0.06 | -0.65 | -0.04 |
| Washington DC[d] | -0.21 | 1.10 | 1.45 | 2.61 | 1.09 |
| Detroit | 1.61 | -0.91 | -0.25 | -0.01 | 0.34 |
| Houston[g] | 0.42 | 1.60 | 1.39 | -0.03 | 0.81 |
| Los Angeles | 0.88 | 3.13 | 1.97 | 1.12 | 1.57 |
| Louisville | 0.11 | -0.23 | 0.53 | 0.58 | 0.29 |
| Las Vegas[h] | – | – | 1.75 | 1.83 | 1.78 |
| Memphis | -0.47 | 1.41 | 0.23 | 1.56 | 0.45 |
| Miami[a] | 2.93 | 4.12 | 1.19 | 3.12 | 2.55 |
| Minneapolis | 0.13 | 1.03 | 1.65 | 2.02 | 1.14 |
| New Orleans[b] | -0.70 | -0.19 | 1.56 | 1.00 | 0.43 |
| Nashville | -0.65 | -0.25 | 1.22 | 2.23 | 0.61 |
| New York | 0.51 | -1.50 | 2.07 | 3.96 | 1.48 |
| Pittsburgh | -0.14 | -1.36 | 0.90 | -0.01 | 0.03 |
| Philadelphia | 0.18 | -2.10 | 1.31 | 2.13 | 0.64 |
| Phoenix[c] | -1.56 | 3.21 | 1.61 | 2.50 | 1.49 |
| Portland, OR[i] | 1.92 | 0.80 | 2.23 | 3.85 | 2.32 |
| San Diego | 2.46 | 3.88 | 2.62 | 3.37 | 2.91 |
| Seattle[j] | 2.36 | 3.63 | 4.11 | 3.26 | 3.32 |
| San Francisco | -0.27 | 1.73 | 3.24 | 2.79 | 1.75 |
| Salt Lake City | -0.44 | 2.76 | 1.85 | 1.43 | 1.11 |
| St Louis | 0.16 | -2.48 | 1.40 | 3.34 | 0.88 |
| Tampa Bay[k] | -0.49 | 3.23 | 1.66 | 2.22 | 1.54 |
| HH Nat'l | 0.16 | -0.56 | 1.50 | 2.28 | 0.94 |

Note: *Values: arithmetic mean over annual real capital gain. HH Nat'l: population weighted. e) begins 1908, f) begins 1911, g) begins 1900/ends 2005, h) begins 1943, i) begins 1898, j) begins 1897, k) begins 1905. These are gross gains and do not account for any costs of ownership, such as depreciation or maintenance.*

2000 and .94% a year on average over the entire 1890-2006 period. Average national gains were close to zero in the 1890-1929 period and negative in the 1930-1945 period. The average national gain increased to 1.5% in the 1946-1980 period and then 2.28% in the 1981-2006. These values are reported at the bottom of Table 2.

A few caveats are in order. We do not attempt to adjust for depreciation or maintenance (Harding et al., 2007). However, our findings confirm that the inflation-adjusted gain in housing prices was quite low even without these adjustments and that, with them, the capital gain associated with housing ownership was likely negative over the entire 1890-

1945 period. In addition, while we do not attempt to decompose our indices into prices for land or structures (Davis & Heathcote, 2007), we can create housing price indices for each city separately to investigate how the gain associated with owning housing has varied across cities.

Table 2 also reports the capital gain associated with homeownership for each of the 30 HiPHoP cities, again with the arithmetic mean over the real capital gain averaged across four time periods. For the period from 1890-1929, although the capital gain was small or even negative for most cities, coastal cities such as Miami, San Diego, Portland, and Seattle already had average annual values over 2%. The period from 1930-1945 saw the capital gain associated with housing fall in most cities. The biggest losers were Rust Belt cities such as St. Louis and Pittsburgh. Even New York City posted a negative average gain of -1.5% over this turbulent period. However, cities on the south and west coast had mostly positive capital gains, even during the Depression and World War II era. In fact, housing in coastal cities such as Seattle and San Diego have had substantially above-average gains in every period since 1890. On the other hand, Detroit has had negative average capital gains in every period since 1929.

Figure 5: HiPHoP 30-City Real HPI by Region, 1890-2006

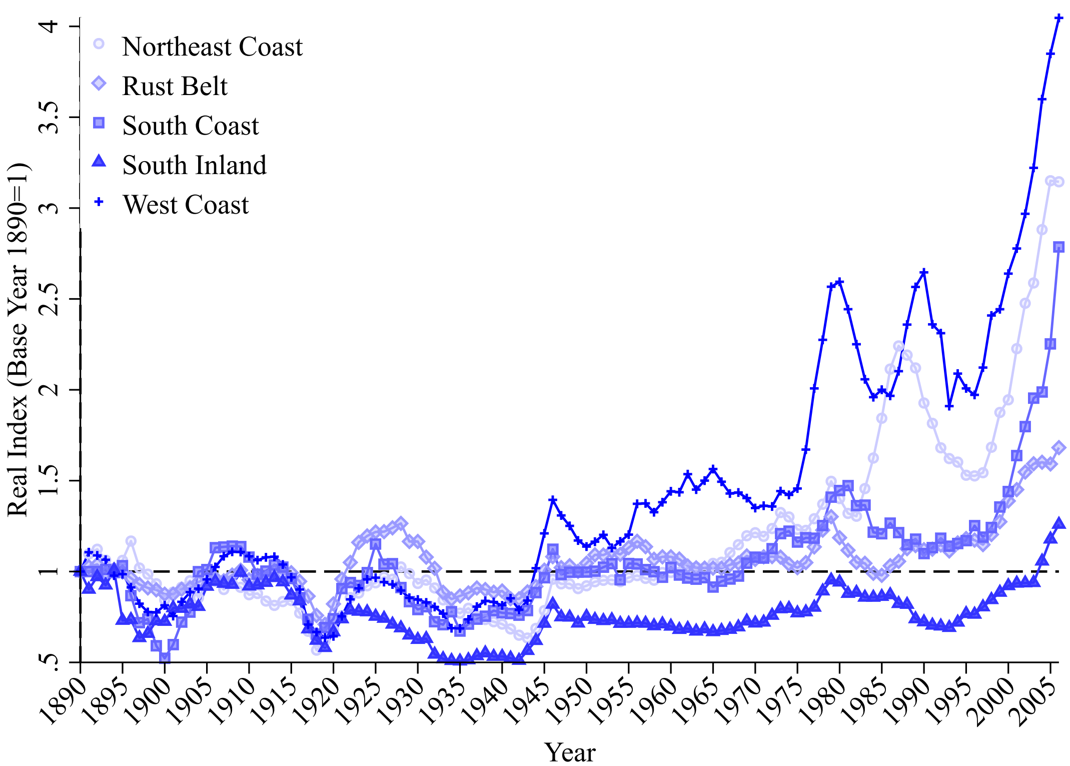



Table 2 suggests a strong regional component of housing price appreciation. In Figure 5 we show housing price appreciation by region, with the HiPHoP sample cities broken into five subsamples: the northeast, the "Rust Belt", the south coast, the south inland and the west coast. Indices adjust for inflation and are set to 1948=1, reflecting the entry of the final city, Las Vegas, into the index in that year. The smallest cumulative increases in inflation-adjusted housing prices occurred in the "Rust Belt" and in the south inland region, while the largest increases occurred in the West Coast cities. As shown in Table 2, increases in Western cities were observable before the late 1940s; in most other regions, prices in the 1950s – and in many cases in the 1980s or 1990s – are similar to what they were in the pre-WW1 era, adjusting for inflation.

## 8 Why did housing price trajectories vary across cities?

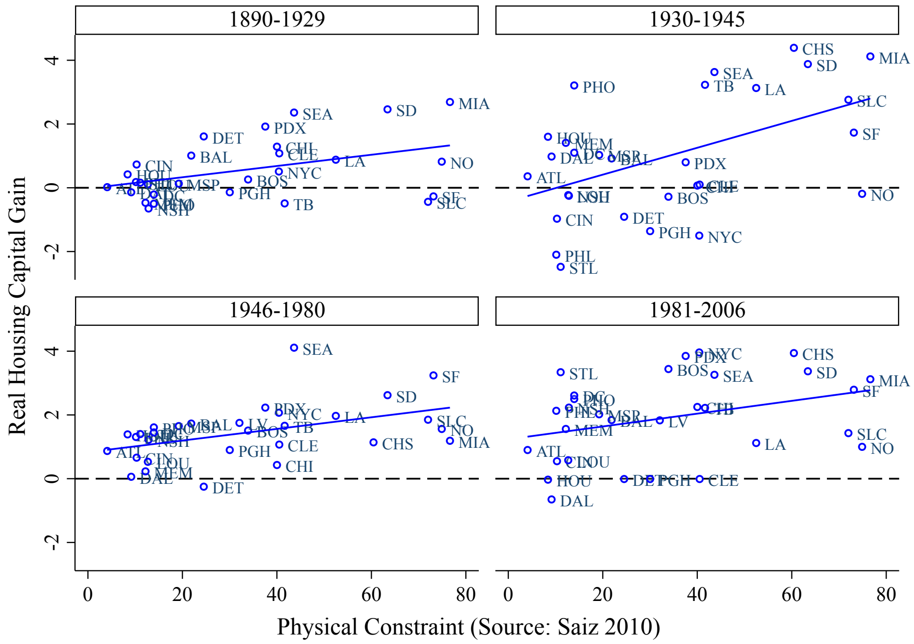
We have thus far shown that the price of owned housing has increased at several points over the twentieth century, particularly beginning in the 1970s. However, we document very different price growth across cities. In this section we examine why housing prices may have increased at different rates across cities over the long run. The canonical models of housing prices emphasize the cost 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. In this section we focus on two factors, land availability and and land use regulation, and ask how they shaped housing price appreciation at different points over the twentieth 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 HiPHoP dataset. In Figure 6a 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 across the twentieth century. The land availability measure is based on topography and water and is thus invariant to development at a point in time.

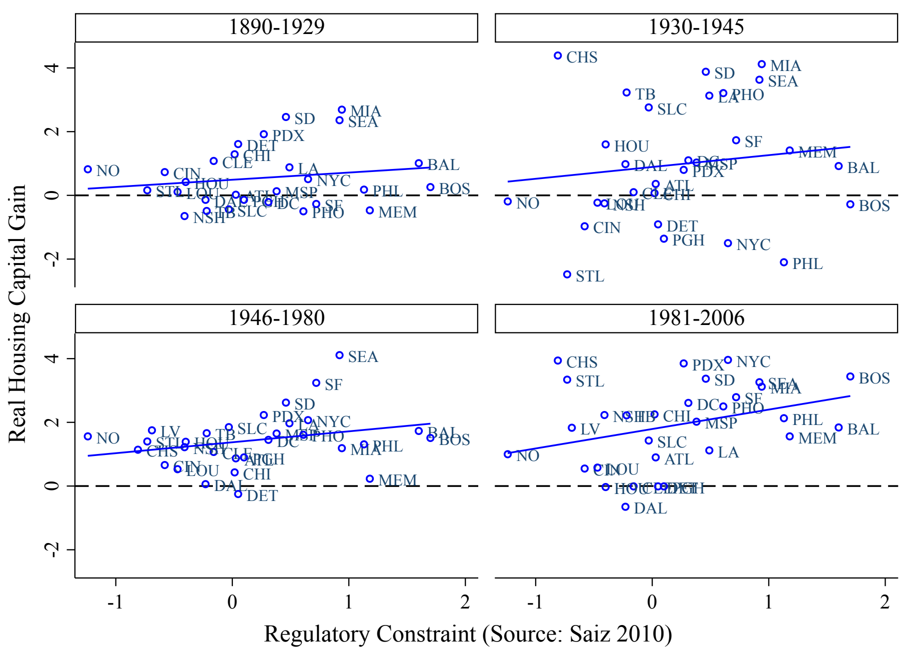
The findings are surprising. One may have expected that land availability would become more important over time as cities became more developed, and in fact Saiz (2010) shows that land availability was positively associated with housing price growth (as measured by the census) between 1970 and 2000. Yet we find the steepest gradient between price growth and land availability over the 1930-1945 period (coefficient of .042). 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 conditional on geographic restrictions of a particular urban area, which reduced the correlation between price growth and land availability in the postwar era. We see a positive gradient in every period though, with the slope coefficients similar and about half the size in other periods relative to the 1930-1945 period.

Figure 6a suggests that housing price growth is not the result of cities having suddenly run out of developable land towards the end of the twentieth century. But certainly something has changed since the 1970s. We next produce a set of scatterplots with the HiPHoP annual average capital gain plotted against the regulatory constraint from Saiz (2010), which is based on the Wharton Residential Urban Land Regulation Index (Gy-

Figure 6: Correlations between Constraints and Housing Price Growth




(a) Physical




(b) Regulatory

ourko 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 6b shows the correlation in each period. Consistent with the arguments made by Fishel and Trounstine, cities that would go on to report the most restrictive land use regulation already appeared to have higher home price appreciation in the 1890-1929 period, although the gradient is fairly shallow (coefficient of .22). Zoning was adopted by almost every city in our sample during the 1920s, so to the extent that zoning regimes are persistent, it is possible that zoning caused higher home price growth even in this period. However, because zoning wasn't a substantial barrier to construction in prewar cities, we believe it is more likely that the positive slope is an instance of higher prices causing future zoning adoption rather than the other way around.

We see a slightly steeper gradient over the next two periods (.37 and .34, respectively). In these periods it is both possible 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 much steeper, however (coefficient of .6), suggesting a closer relationship between zoning and home price appreciation towards the end of the twentieth century. The fundamental endogeneity here is difficult to unpack without better information on historical zoning regimes. However, we speculate based on the evidence presented here that land availability was more closely related to housing price growth before World War II relative to after, and that in recent decades land use regulation has become a more important driver of across-city differences in housing price growth, consistent with recent scholarship such as Gyourko and Krimmel (2021).

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## B 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 this data to the decennial census, the most commonly-used source of housing data for U.S. cities.

### Newspaper Data

Table 3: 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.*

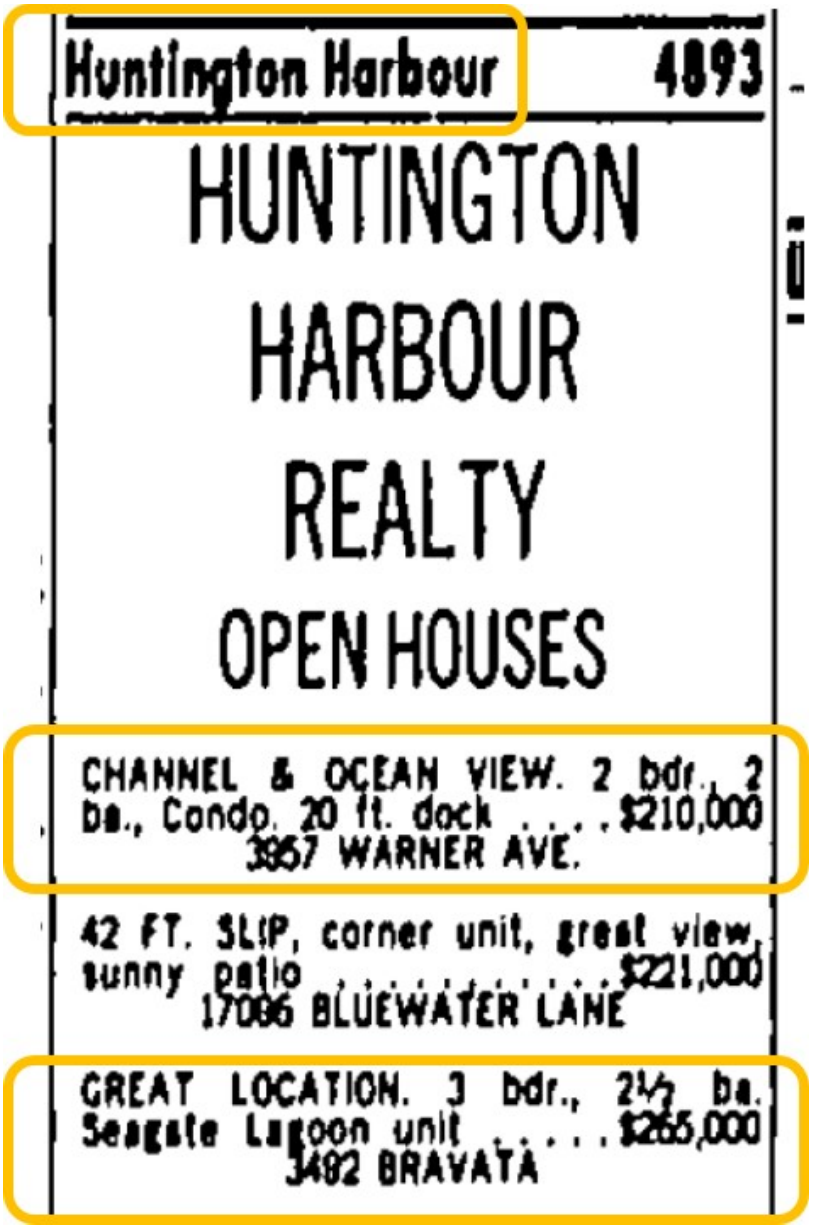
The listings from each city were obtain by sampling the residential real estate sections of newspapers published in each city. Our sampling procedure aimed to identify 150 rental and 250 sales listings from each sampled newspaper, typically the last Sunday of the month of interest. Research assistants sampled across all columns in the real estate section so that any areas covered 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 7 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 C) for details). The second listing is not valid because there is no measure of size.

We included a city-year-segment triad in the dataset if we could obtain at least thirty valid listings without a sub-city measure of geography. 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 start in 1920, the latest is Las Vegas, where housing market listings existed in sufficient numbers only by 1948. The start date for the sales and rental series are listed in Table 1. We only digitized 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 observations counts for each city in Table 4. 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 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, 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.

Figure 7: Example of Valid Listings



Huntington Harbour 4893

HUNTINGTON HARBOUR REALTY

OPEN HOUSES

CHANNEL & OCEAN VIEW. 2 bdr., 2 ba., Condo, 20 ft. dock . . . . . $210,000
3857 WARNER AVE.

42 FT. SLIP, corner unit, great view, sunny patio . . . . . . . . . . $221,000
17086 BLUEWATER LANE

GREAT LOCATION. 3 bdr., 2½ ba. Seagate Lagoon unit . . . . . $265,000
3482 BRAVATA

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

Table 4: Observation Counts and Missing Years

| City | Total Number of Observations | Missing Years |
|---|---|---|
| Boston | TBD | – |
| Chicago | TBD | – |
| Los Angeles | TBD | – |
| New York | TBD | – |
| Washington D.C. | TBD | 2006 |
| Miami | TBD | – |
| Detroit | TBD | – |
| Phoenix | TBD | 1930 |
| New Orleans | TBD | – |
| San Francisco | TBD | – |
| Philadelphia | TBD | 1890 (rent) |
| Louisville | TBD | – |
| Dallas | TBD | 1892, 1894, 1895, 1945, 1946 (rent) 1892-1894 (sale) |
| Atlanta | TBD | 1944-1947 (rent) |
| Cincinnati | TBD | – |
| Baltimore | TBD | – |
| Charleston | TBD | 1918-1920, 1942-1945 (rent) |
| Cleveland | TBD | Incomplete |
| Houston | TBD | 1946, 2003 (rent) 1925, 1927 (sale) 1964, 2006 |
| Las Vegas | TBD | 1951 (rent) |
| Memphis | TBD | 1890, 1892 (rent) 1892-1894 (sale) |
| Minneapolis | TBD | 1946 (rent) 1896 (sale) |
| Nashville | TBD | 1920, 1945, 1946 (rent) |
| Pittsburgh | TBD | Incomplete |
| Portland | TBD | 1993, 1995 (sale) |
| Salt Lake City | TBD | 1890, 1900, 1942, 1946 (rent) 1894, 2005 (sale) |
| San Diego | TBD | Incomplete |
| Seattle | TBD | Incomplete |
| St. Louis | TBD | 1946 (rent) |
| Tampa | TBD | Incomplete |

Note: *The table lists the city in the sample, the total number of observations for the city, and the missing years for the city.*

### Benchmarking HiPHoP to the Census

Figure 8 shows the distribution of housing prices from HiPHoP and the census for select city-years pairs chosen to illustrate the typical cases of distributional overlap. The first case is that the distribution of HiPHoP sales aligns well with the census owned housing 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 is shown for Philadelphia in 1970 in panel *b*, when our HiPHoP sales data is 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 contains more information on the upper end of the housing market relative to the census, particularly in years with binding topcodes like 1970.

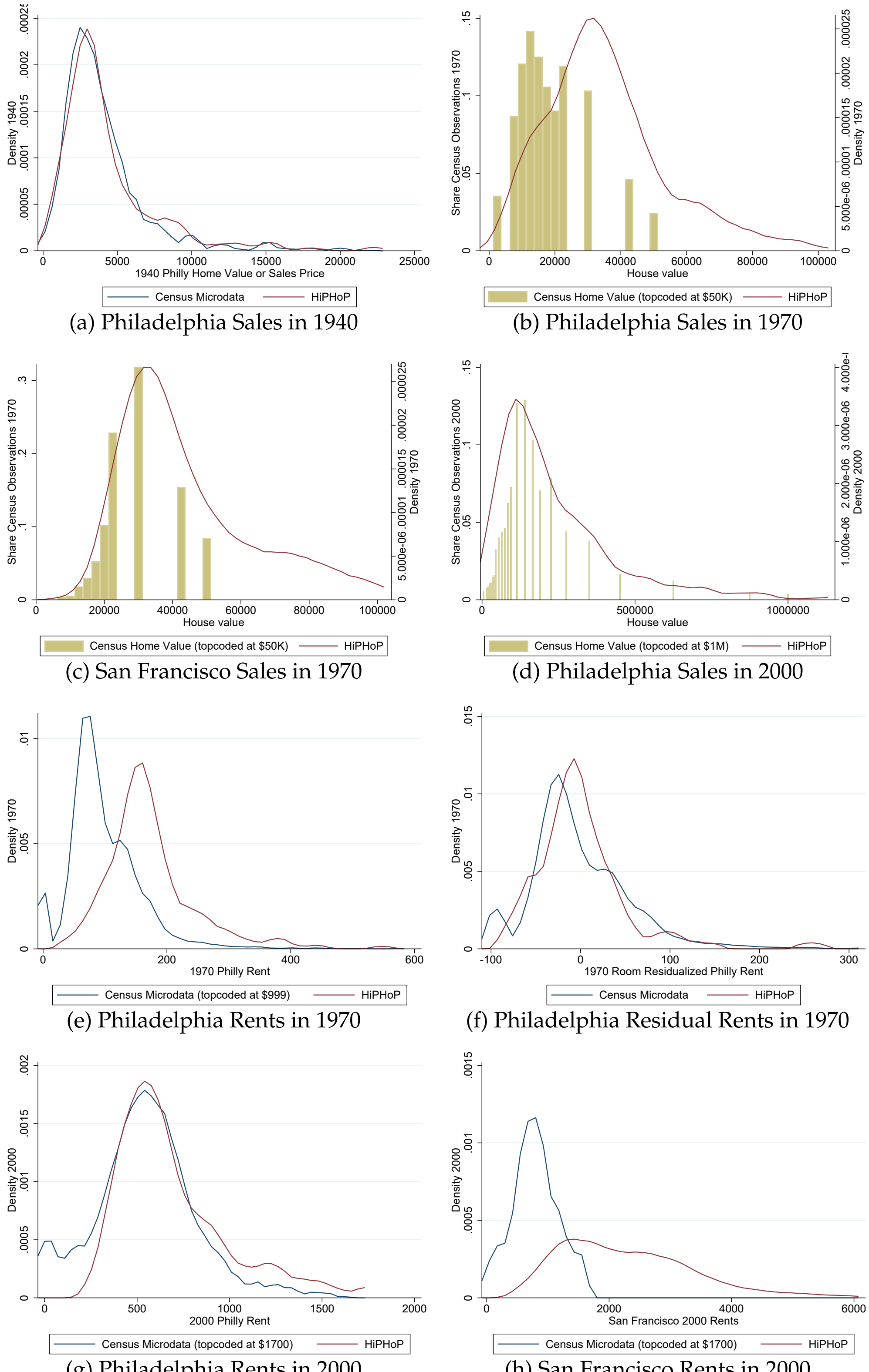
What is driving the rightward shift of our data relative to the census in cases such as Philadelphia in 1970? One explanation is limited homeowner awareness of nominal price inflation, which was greater in the 1960s relative to earlier decades. However, owner-reported values and HiPHoP sales data are back in alignment by 2000, right before the dot.com bubble burst, 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 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 listed rents and rents reported by households in the census in the next four panels of Figure 8. 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 HiPHoP data and reported values from the census. It is clear that the HiPHoP 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 Figure *f*. The residualized rents show a much closer alignment, suggesting that our controls in the hedonic specification should be effective. However, in many city-year pairs we find a close alignment between census and HiPHoP rents even without adjusting for housing unit size, for instance see panel *g* for Philadelphia in 2000.

However, 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 HiPHoP 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 covers a very selected portion of the rental housing stock in the city of San Francisco, namely units

Figure 8: 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

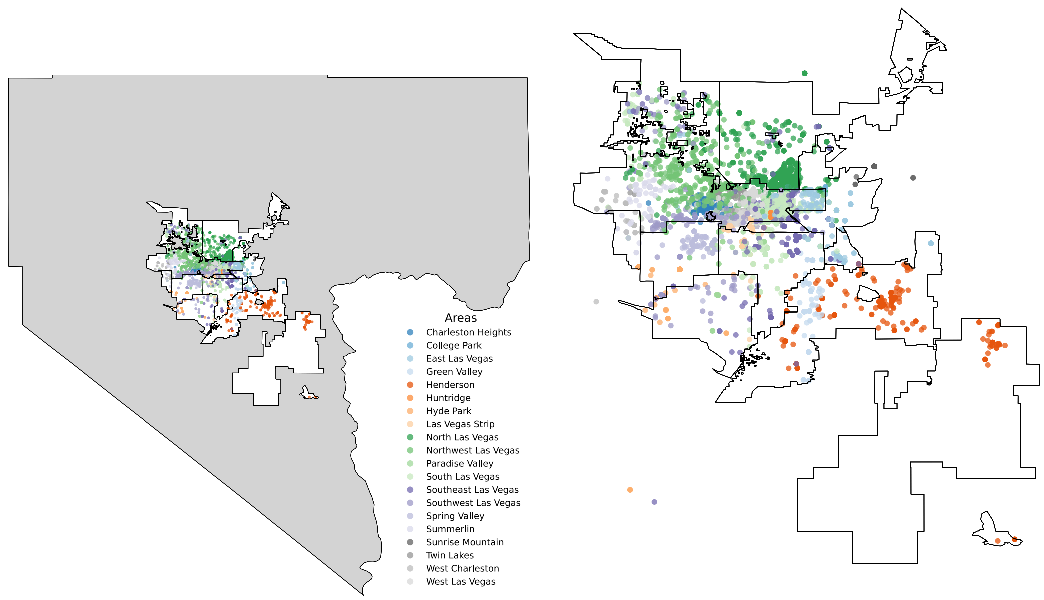
(g) Philadelphia Rents in 2000

(h) San Francisco Rents in 2000

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. This share of the rental stock being rented at market prices ranges from a small minority in San Francisco in 2000 to virtually every unit in most cities outside of the WWII era.

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 HiPHoP data relative to the census. To the extent that these shifts are driven by sticky rents or inaccurate homeowner valuations, our data is 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 HiPHoP 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 twentieth century.

# C Geocoding




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

Figure 9: Example of Geocoding and Area Classification, Las Vegas

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 for our listings. A valid listing requires 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 ”West Philadelphia.” For some southern cities such as New Orleans prior to the Fair Housing Act, an important column heading was ”Colored” or similar to indicate neighborhoods 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 we would identify off of enough listings given our relatively small samples in each year (listings can also have a ”missing” area designation). The top twenty areas are based off the entire 116 year period, so in early years may not have all twenty in every city. There may be no sub-city location information at all in early years, or there may be only a handful of areas, depending on how developed the city was. For instance, New York City has twenty areas over the whole sample while Salt Lake City has ten in 1890; many listings were assigned to the missing category in early years.

Our process is as follows: upon receiving the digitizing listings, we first formed an address or generation location to the best of our ability using the information in the listing and newspaper. 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 direction, for instance southwest Chicago. In early years, we relaxed the requirement to have sub-city geographic information if this requirement yielded a very small number of listings.

We next ran the address or general location through Open Street Map to get a latitude and longitude. There are two types of outcomes. In the first case, we had a latitude and longitude along with an area from the newspaper. In the second case, we essentially had only an area, and the geocoder is returning the centroid of some area, or even the centroid of an entire city.

We then took observations from the first case 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, sales, and income properties) to predict neighborhood. We use this model to add the neighborhood to observations without one (for instance, only an address). For observations that only had 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 9 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.

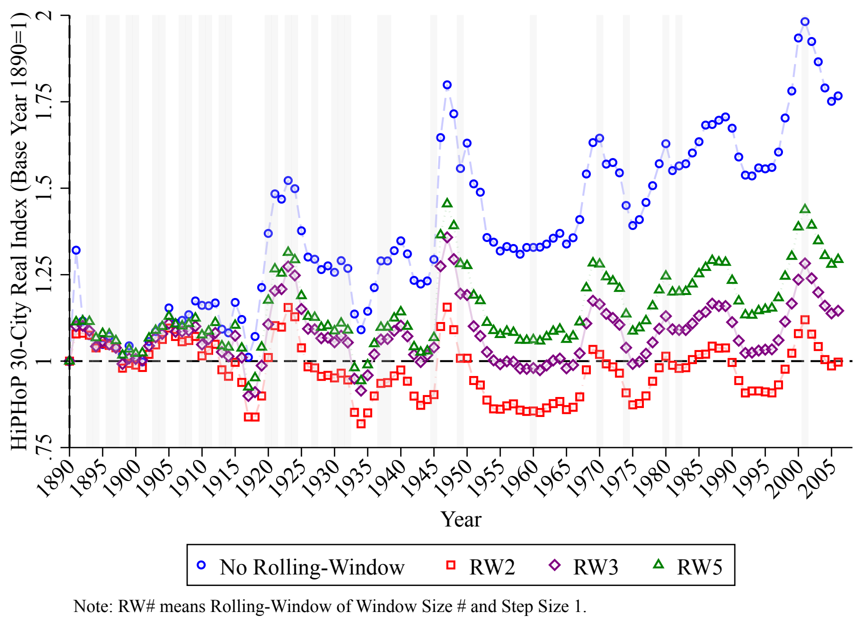
# D Supplemental Results

Here we present supplemental results. In Figures 10a-10b, we outline how our rent and sale price indices very across rolling windows. The 'No Rolling Window' specification is an all-in-one regression, pooling data from all years; as described above, this means imposing fixed price relativities – 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; this pattern continues with rolling window length: the index in 2005 is closer to 1, the smaller the rolling window.

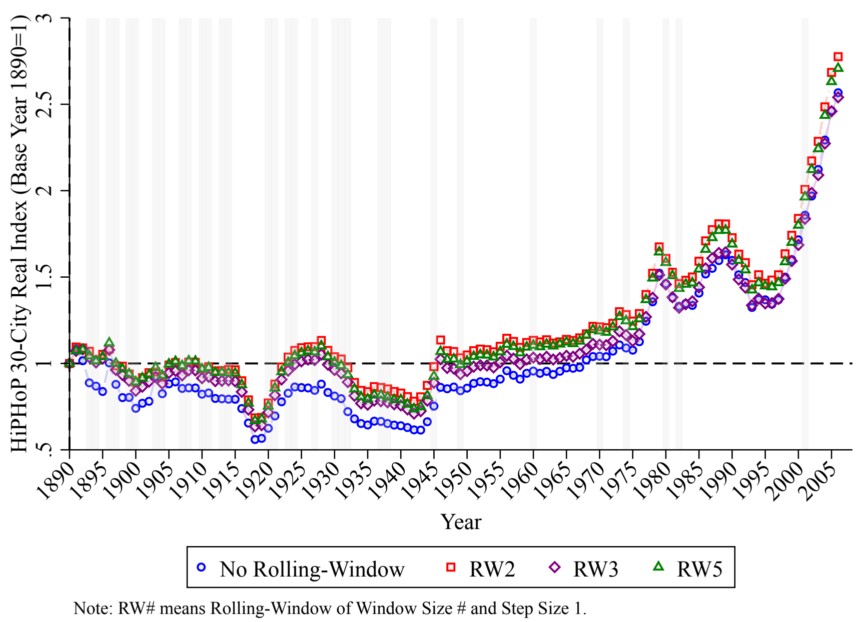
Figure 11 presents for all thirty cities inflation-adjusted rental price indices from 1914 to 2006, per HiPHoP. The red series, where included, is the BLS ROPR series for that city. In addition to very different trajectories in some cities, such as Portland and Cincinnati, the coverage of the ROPR series is much less detailed.

Figures 12 and Figure 13 present equivalent city-level indices for sale prices, comparing HiPHoP indices against firstly FHFA city-level indices (from 1975) and secondly the S&P/Case-Shiller index from 1987. There is, in general, a remarkable degree of similarity in price trends, as seen in for example New York or Miami across HiPHoP and Case-Shiller and Phoenix or Tampa in the FHFA series.

Figure 10: HiPHoP 30-City Real Indices by Rolling Window Size, 1890-2006




(a) Rent




(b) Sales

Figure 11: Comparison to BLS Real Rent Indices, 1890-2006

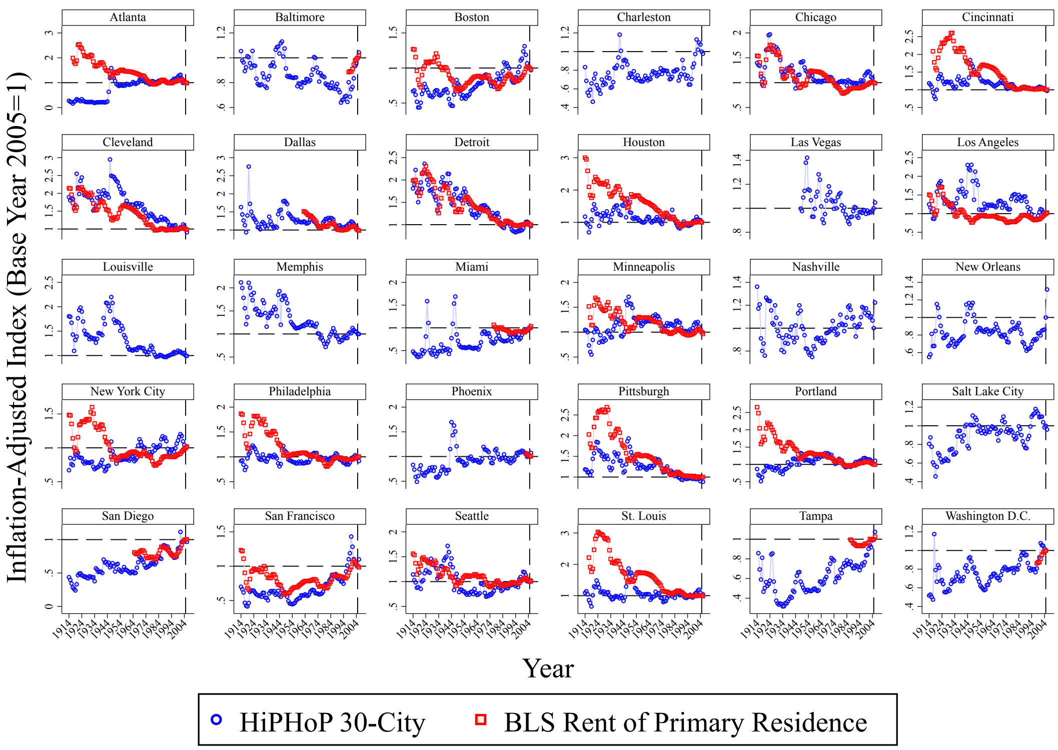


Figure 12: Benchmarking against FHFA Real House Price Indices, 1975-2006

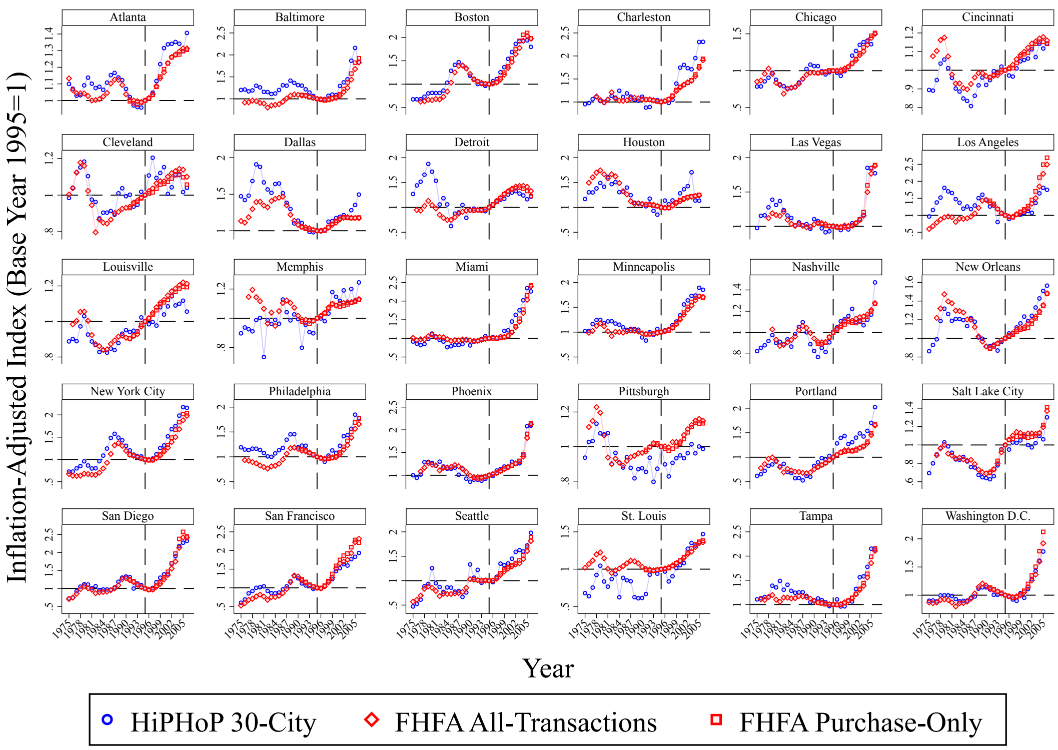


Figure 13: Benchmarking against S&P/Case-Shiller Real Home Price Indices, 1987-2006