Rental Prices and the Cost of Living in the United States, 1914–2006

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Disclaimer

The views expressed in this presentation are solely those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

Separately, we're delighted to have the opportunity to present and look forward to your feedback and comments, so that we can improve the paper.

Structure

- **Motivation**
- Revised Rental Prices
- Revised Shelter Shares
- Revised CPI
- Conclusion

Motivation

- Shelter was roughly one quarter of household spending across the 20th century
- In the official CPI (from 1914), Rent of Primary Residence (ROPR) rose just 2.6% p.a. vs 3.3% p.a. CPI-ex-shelter (1914-2006) → "falling" real rents puzzle
- Measurement issues behind the puzzle
  - Pre-1983 CPI treated home purchases, mortgage interest, taxes → asset/financing noise as housing costs
  - Sticky rents & vacancy bias (tenant surveys 1942-1985) understated rent increases
  - Quality change unobserved: aging, renovations, adoption of amenities (e.g. central heating)
- Policy & research milestones
  - Stigler Commission (1961) → advocate Owners' Equivalent Rent (OER)
  - Boskin Commission (1996) → highlight housing biases in CPI
  - BLS revisions: from dwelling to household survey for rents (1940s), rent-sample overhaul (1978), OER adoption (1983)

What's "wrong"? Known limitations of existing measures

- Active debate on rent and inflation measures: e.g. Penn State/ACY Alternative Inflation Index
- The **share** of shelter in total household expenditure
  - Homeownership not included until 1950s
  - Homeownership included 1950s–1980s using acquisitions approach
  - Year-to-year jumps (related to above plus switch to CPI-U)
- The **price** of shelter paid by households
  - Vacancy resets and "sticky rents" — identified within a few years (Humes et al/MLR 1940s/1950s) – both a trend rate issue and a volatility issue
  - OER: target of using market rents (Ozimek)
  - For 1950s–1980s, Greenelees critique for acquisition prices
- **Implication:** Desireable to have a methodologically consistent shelter series to better gauge true changes in the cost of living in the U.S. over the long run

Our Revised CPI (1914-2006): Approach & Insights

- Standardize shelter treatment back to 1914
  - Use modern concept: Shelter → ROPR + OER (service flow for all households)
  - Derive OER by imputing rents from market-rent data each year
- Data innovations
  - Historical Housing Prices (HHP) index for market rents (1914-date)
  - BEA tenant-to-imputed-rent ratios (1929-) to reconstruct shelter's basket share
  - Align with BLS post-1987 weights; splice for earlier decades
- Key findings
  - Revised CPI shows significantly higher long-run inflation than official series
  - Difference stems mainly from faster market-rent growth vs ROPR & homeowner costs (1953-83)
  - Shelter's share remains within historical bands but is conceptually consistent
- New benchmark CPI for analyzing U.S. cost-of-living trends (1914–2006): 3.6% vs 3.3% official

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Dataset Construction

- Roughly 1.23 million rental listings (30 cities) from Sunday real-estate pages, 1914-2006
  - Similar in spirit to Rees-Jacobs (1961) for 1890-1914 – but allowing quality adjustment/hedonics (following Griliches, Rosen and others)
  - Public data release via Philadelphia Fed HHP portal
- Sampling & variables
  - Target of 150 valid ads per issue: where valid = price + size + type + location
  - Size proxy: total rooms (pre-WWII) $\rightarrow$ bedrooms (post-WWII)
  - Location standardized into 20 metro sub-areas per city using ML classification
- Methodology for “like-for-like” rents
  - Hedonic regressions with controls for size, property type & location
  - Two-year rolling windows $\rightarrow$ coefficients allowed to drift with market evolution
  - Addresses mix-change & long-run quality shifts; avoids need for repeat-rent pairs (rare in historical data)
- First nationwide, mix-adjusted rental price index spanning 1914-2006

Index Construction; Regression Specification

- Regression framework:

$$\ln(\text{Price})_{ict} = \alpha + \underbrace{\sum_{y=\min(Y), y \neq BY}^{\max(Y)} \beta_{cy} \cdot 1_{(y-t)}}_{\text{coefficients of interest}} + \underbrace{X\Gamma}_{\text{Controls}} + \varepsilon_{ict}$$

Index Construction: Specification Components

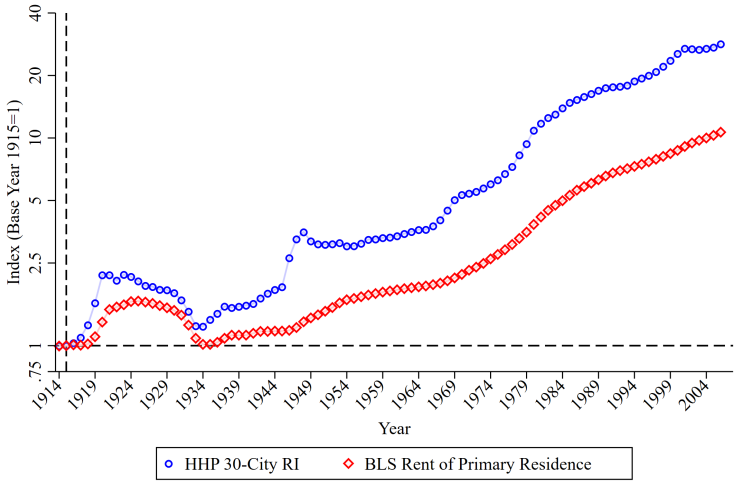
- Controls (all categoricals, to allow for missing characteristics)
  - Size dummies (rooms / bedrooms / bathrooms)
  - Dwelling type (house vs apartment)
  - Standardized intra-city location (20 zones)
  - Rental payment frequency (monthly / weekly / annual)
- Prices converted to monthly terms
  - Frequency imputed for missing ads via percentile rule $\rightarrow$ unknowns cut to 33 k from 1.23 m
- Two-year “rolling-window” estimation – up to 92 regressions (1914-2006) per city
  - Longer windows or interpolation used if listings sparse (e.g., WWII rent control years)
- Aggregation from city to national
  - Year-to-year city change = $\exp(\beta_t)$; chain forward to level series
  - Population-weighted aggregation across 30 MSAs $\rightarrow$ national rent index

The HHP Rental Index

- HHP Market rents ↑ $\times$**28.4** vs. ROPR ↑ $\times$**10.7**
  - Annual growth: 3.55 % (HHP) > 2.51 % (ROPR)
- Result: rents kept pace with CPI-ex-shelter (3.3 % p.a.) rather than lagging far behind.
- High inflation driving the divergence
  - 1914-1920: HHP +119 %; ROPR + 35 %
  - 1945-1948: HHP +84 %; ROPR + 11 %
  - 1965-1980: HHP 3x; ROPR 2x (esp 1965-9, 40 %v10% and 1977-80, 50%v25%
- HHP captures open-market (vacancy) rent resets missed by legacy CPI methods
  - Using HHP rents aligns shelter inflation with overall price growth, eliminating the long-standing “falling real rents” puzzle and raising measured long-run inflation

HHP Rental Index: Graph

Figure 1: HHP Rental Index vs. BLS RoPR Series



Note: Panel (a) of this figure plots the baseline HHP rental price series against the BLS RoPR series with base year of 1914.

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Existing Shelter Share

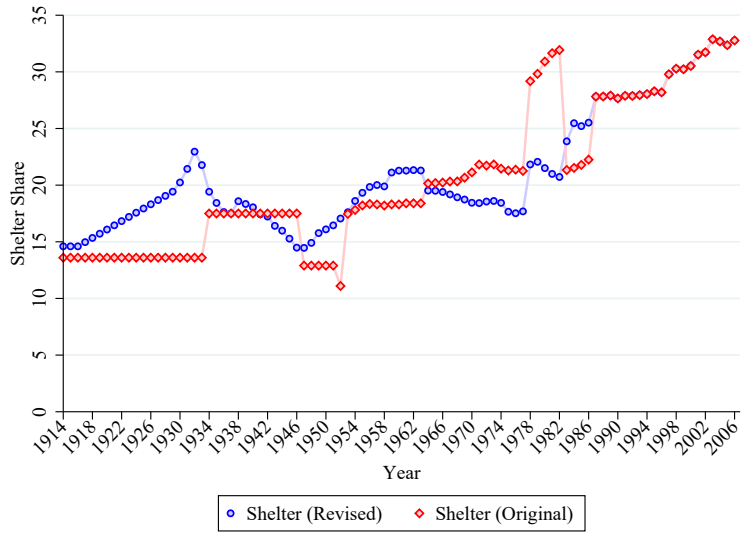
- Backbone: Consumer Expenditure Surveys since 1919
  - Annual relative-importance weights available from 1952 onward
  - 2006 CPI-U weights: Housing 42.7%
- Milestone methodology shifts & impacts
  - 1953: homeowner costs added (new “HP&FTI” category), shelter share jumps 11.1% $\rightarrow$ 17.5%
  - 1978: switch from CPI-W to CPI-U, HP&FTI weight 12.6% $\rightarrow$ 19.2%, pushing shelter share to 21.3%
  - 1983: introduction of Owners’ Equivalent Rent (OER), homeowner shelter share 22.5% $\rightarrow$ 13.9% (conceptual upgrade from purchase/interest costs)
- Underlying trend during periods of stable methods clearly upwards
  - 1953-1977: Shelter +0.16pp per year $\Rightarrow$ 17.5% $\rightarrow$ 21.3%
  - 1987-2006: Shelter +0.26pp per year $\Rightarrow$ 27.8% $\rightarrow$ 32.8%
- Despite step-changes from methodological revisions, shelter’s consistent upward drift makes it the single largest CPI component—driven largely by the expanding role of OER in measuring owner-occupied housing costs

Revised Shelter Share

- Applying today's OER+rent concept consistently back to 1914
- 1987-2006 (OER era): take published CPI relative-importance weights for shelter
- 1953-1986 (home-purchase era)
  - Remove HP&FTI component from CPI, rescale Rent of Primary Residence (ROPR)
  - Use BEA ratio (Imputed Rent ÷ Tenant Rent ≈ 2.5), to calculate OER, aligning level to 1987
- 1929-1952 (pre-homeowner CPI): Track year-to-year %-point changes in BEA PCE share for (tenant + imputed) rent. Anchors at 17.6% (1953) and 19.4% (1929)
- 1914-1928 (earliest period): Use BLS surveys 1917-19 & 1934-36 to estimate 1914 level and linearly interpolate to 1929
- Resulting series: within similar scale as before (15-25% 1914-1986) but different timing in trend – shelter share peaks in 1931, reaches a low in 1947 and peaks again in 1962 Joins BLS path in 1987, rising shelter share, reaching 32.8% by 2006
- Outcome: continuous, methodologically-consistent shelter share for revised CPI

Original and Revised Shelter Share

Figure 2: Original and Revised Shelter Share



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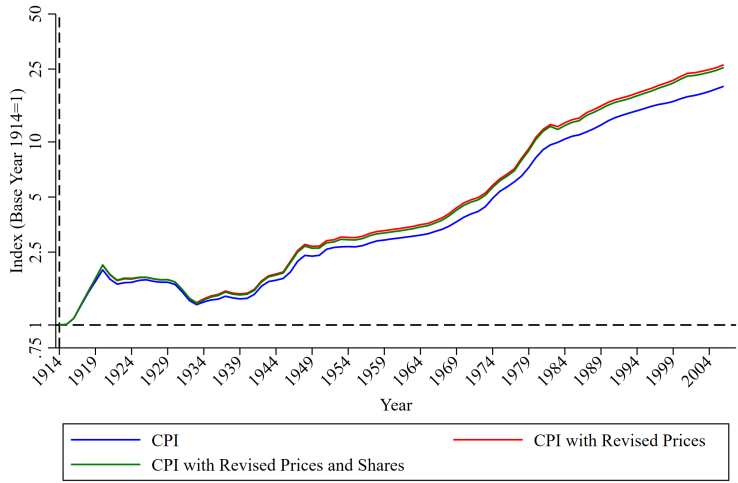
The Revised CPI (1914-2006)

Figure 3: Consumer Price Index for Urban Consumers vs. Alternate HHP CPI



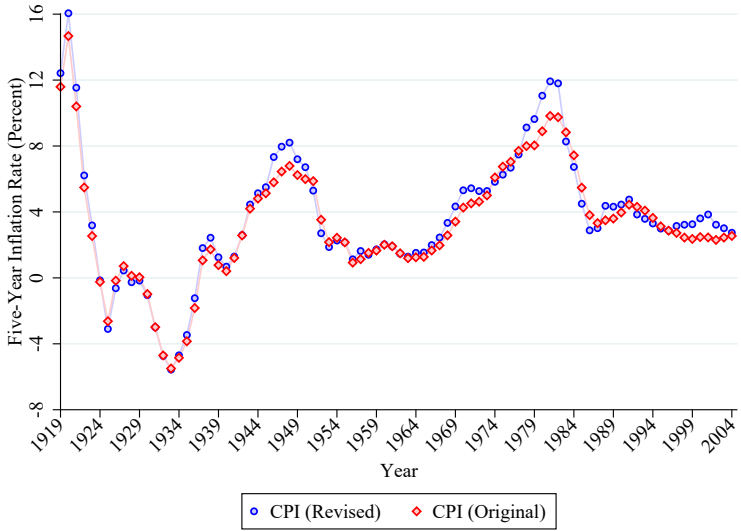
Note: This figure shows the Consumer Price Index for Urban Consumers (CPI-U) and an alternate CPI that has the total housing component replaced in every year with HHP rental series.

The Revised CPI (1914-2006): discussion

- Shelter component replaced
  - Use HHP market-rent index for both Tenant Rent and OER
  - All other prices = BLS CPI-ex-Shelter
- Weights: base-year Laspeyres shares applied 1914-2006
  - Shelter weight treated consistently through time (avoids 1953 & 1983 breaks)
- Resulting index rises 26.4x, vs official CPI 20.1x
  - Visibly higher path throughout century

What changes? Average inflation over five years

Figure 4: Five-Year Inflation Rate

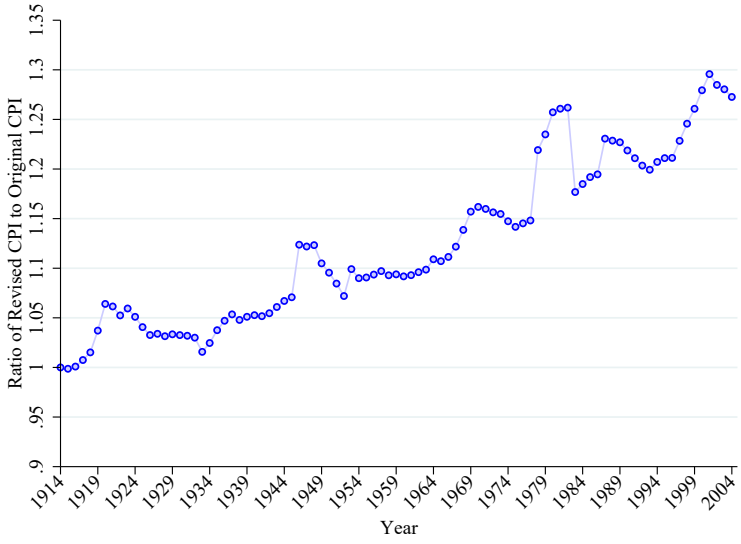


What changes? Inflation, annually and 5-year

- By our measure, consumer inflation was almost one tenth higher 1914–2006 than the official CPI suggests
  - Official CPI-U : 3.3%
  - Revised CPI : 3.6%
  - A 0.3 pp difference, or almost one tenth higher
- Looking at the 5-year average inflation rate, divergence concentrated in high-pressure housing periods
  - 1946-48 post-WW II rent spike
  - Late-1970s/early-1980s vacancy-reset gap (during high inflation)
- Elsewhere differences are modest but cumulative
  - E.g. late 1990s/early 2000s: rental boom captured in HHP but not in ROPR

Cumulative Impact of Better Shelter Share Data

Figure 5: Ratio of Revised CPI to Original CPI



Cumulative Impact of Better Shelter Share Data

- Ratio starts at 1.00 by design (1914)
- Rises steadily as revised shelter grows faster
  - Five percent gap by 1920 – similar in 1945
  - Mid-1940s step-up, partially reversed but gap at 15% by 1970
  - Further surge late 1970s – some volatility (in underlying BEA source) but 20% by 1980s
- By 2000 revised cost of living $\approx$ 30 % higher than official CPI
- Under-measurement is systematic, not one-off
- Take-away: correcting rent/OER bias raises long-run inflation and reshapes 20th-century real income trends

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Conclusion: Thanks for your time and attention

- Motivating question: what would the CPI look like if shelter were treated throughout like it has been the last couple of decades and with market measures of rents?
  - Shelter $\rightarrow$ ROPR + OER (service flow for all households)
  - Derive OER by imputing rents from market-rent data each year
- Data innovations: HHP index for market rents (1914-2006), and consistent shelter share, relying in larger part on BEA tenant-to-imputed-rent ratios (1929-1983)
- Key finding: 3.6% AGR in prices, vs 3.3% official
  - Revised CPI shows significantly higher long-run inflation than official series
  - Difference stems mainly from faster market-rent growth vs ROPR & homeowner costs (1953-83)
  - Shelter's share remains within historical bands but is conceptually consistent
- We hope that this series is a useful addition to the researcher's toolkit – and look forward to the discussion today (and over the coming months)