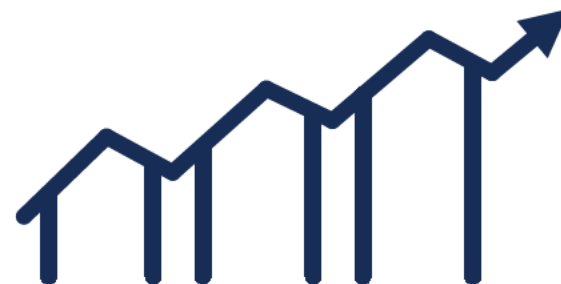Federal Reserve Bank of Dallas
Summer Professional Development for Educators:
Industry, Economy, and You
June 21, 2022

"REAL-TIME MARKET MONITORING FINDS SIGNS OF BREWING U.S. HOUSING BUBBLE"

ENRIQUE MARTÍNEZ GARCÍA (FEDERAL RESERVE BANK OF DALLAS)

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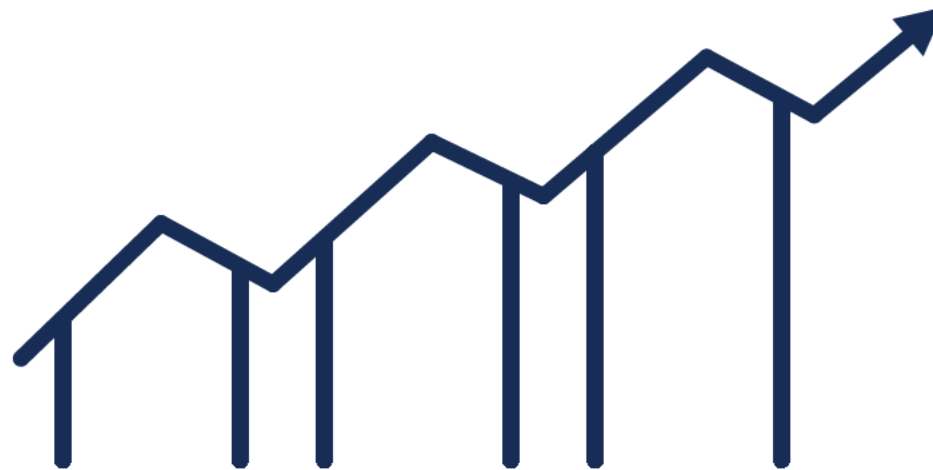
VALERIE GROSSMAN (FEDERAL RESERVE BANK OF DALLAS)

SHUPING SHI (MACQUARIE UNIVERSITY)

PETER C.B. PHILLIPS (YALE UNIVERSITY & UNIVERSITY OF AUCKLAND)
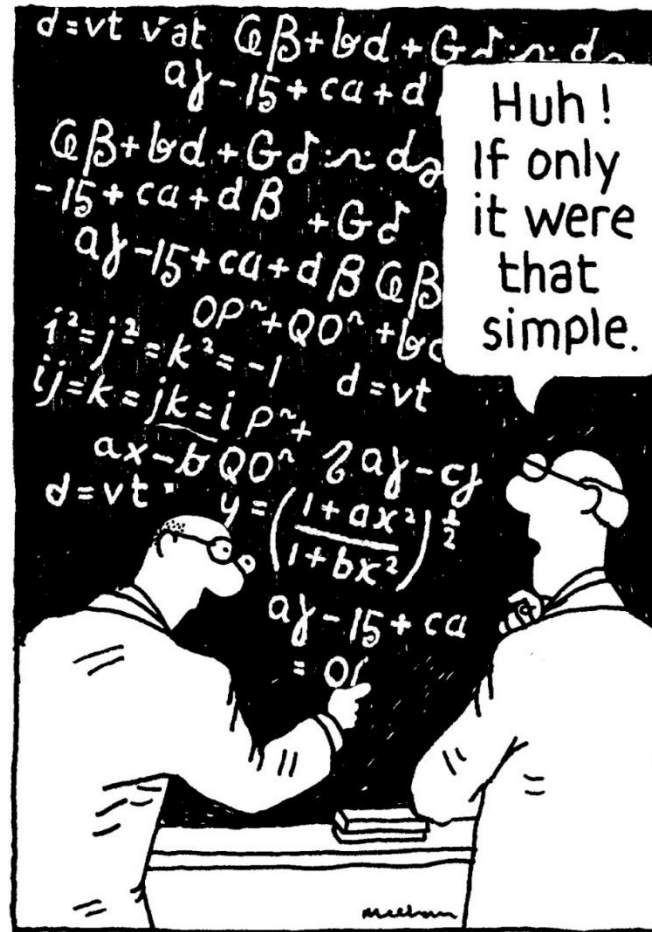
OUTLINE

I. **Monitoring housing markets: Detecting symptoms of exuberance**

II. **Evolution of U.S. housing during the pandemic**

III. **What evidence of symptoms of exuberance do we observe?**

IV. **Concluding remarks: Should we worry about this evidence?**

# 1. DETECTING SYMPTOMS OF EXUBERANCE

WHAT IS A HOUSING BUBBLE?

- **Property I**: A bubble occurs from transactions that depend on the widespread belief that the item purchased would be accepted for transaction purposes by others in the future

    - a rational housing bubble occurs when expectations of future increases of the (log) house price rather than fundamentals drive the log house price up ← fear of missing out (FOMO)

- **Property II**: Asset prices partly driven by a bubble can become explosive, and this poses a problem because explosive price increases are unsustainable and eventually a price correction (or a bust) ensues

    - time series driven by a bubble display two important properties that we can detect in the data

        - they are nonlinear (because they burst)

        - they are (mildly) explosive during their boom phase

- P_t is the price of an asset and can be decomposed as

$$P_t = P_t^* + B_t$$

where P_t^* is the fundamental-based price and B_t refers to a rational housing bubble $\rightarrow$ when $B_t > 0$, the presence of a bubble results in a misalignment between prices and fundamentals
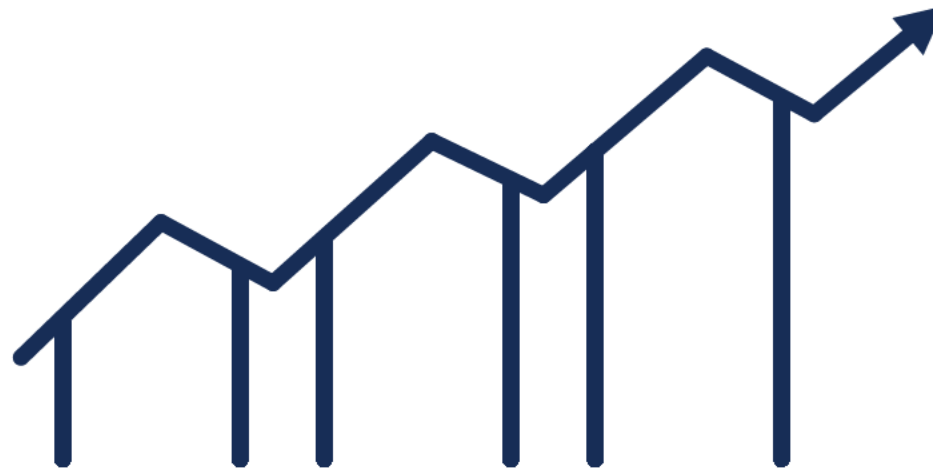
ILLUSTRATING A BUBBLE EPISODE
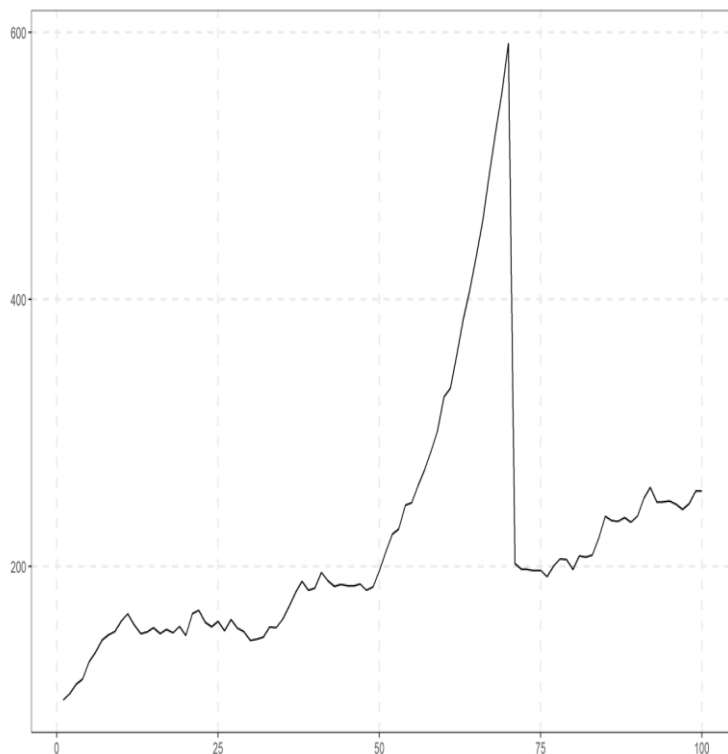
- **Evidence of exuberance (or mildly explosive behavior) is a symptom** consistent with the problem (housing bubble, $B_t > 0$), not *necessarily* a diagnosis → better when the exuberance stats are used in conjunction with other data, indicators

- Evidence of exuberance is generally inherited by the price-to-rent ratio (profitability) & the price-to-income ratio (affordability) → investigate the behavior of both ratios together with real house prices

- Short episodes of exuberance generally do not result in a major misalignment between prices & fundamentals → focus on episodes lasting over a year

BUILDING A CONSISTENT DATASET

- **Dallas Fed International House Price Database**

  - 25 countries – more countries to be added in the future

  - starting data: 1975Q1; updates quarterly

  - benchmark: the FHFA quarterly price series for the U.S.

  - data is publicly available at: https://www.dallasfed.org/institute/houseprice.aspx

    - House prices (real and nominal)

    - Personal disposable income (real and nominal)

  - **Methodology**: Adrienne Mack and Enrique Martínez-García with Valerie Grossman (2011): "A Cross-Country Quarterly Database of Real House Prices: A Methodological Note." Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute Working Paper No. 99 (Revised: January 2018). http://www.dallasfed.org/assets/documents/institute/wpapers/2011/0099.pdf

OUR RESOURCES TO MONITOR EXUBERANCE

- **To be useful in practice, any monitoring tool requires at least two key ingredients**

  - consistent, accurately measured, timely and representative data

  - an appropriate set of metrics with which to infer from the data a consistent and reliable signal about the emergence of a housing bubble (or, more precisely, of its symptoms like explosiveness) in real-time: the SADF and GSADF tests proposed by Phillips and Yu (2011) and Phillips et al. (2015), the panel GSADF test of Pavlidis et al. (2016)

- **An integrated database and toolkit for monitoring international housing markets**

  - International House Price Database: (IHPD) https://www.dallasfed.org/institute/houseprice

  - International Housing Observatory (IHO) in partnership with Lancaster University Management School in the UK, Macquarie University in Australia, and the University of Auckland in New Zealand: https://int.housing-observatory.com/

  - exuber R package implementing statistical procedures used in IHPD/IHO: https://cran.r-project.org/web/packages/exuber/index.html, https://github.com/kvasilopoulos/exuber, https://www.dallasfed.org/institute/wpapers/2020/0383
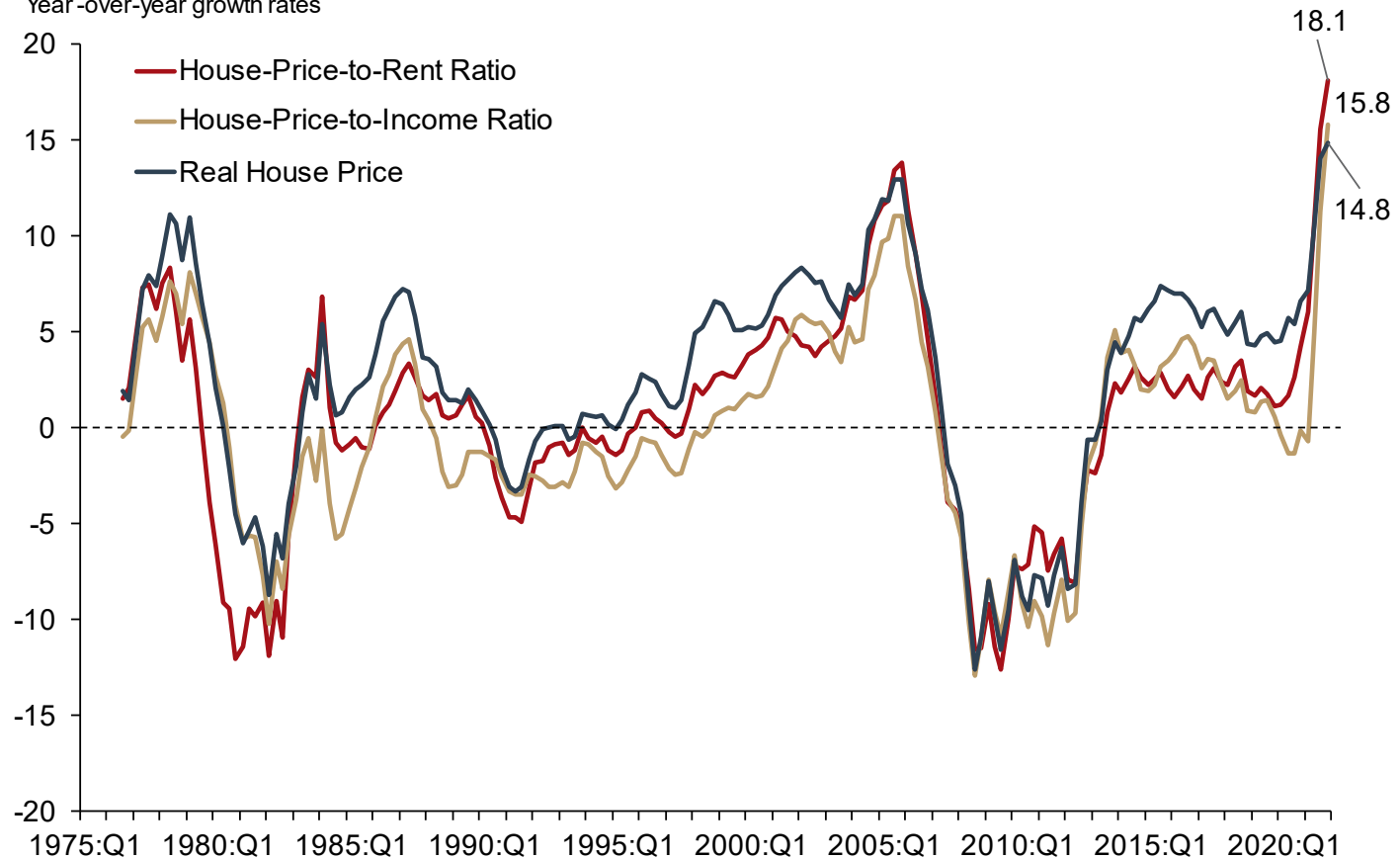
Testing Procedure

II. U.S. HOUSING DURING THE PANDEMIC

HOUSING MARKET BOOMING?

US Real House Prices, House-Price-to-Rent Ratio and House-Price-to-Income Ratio
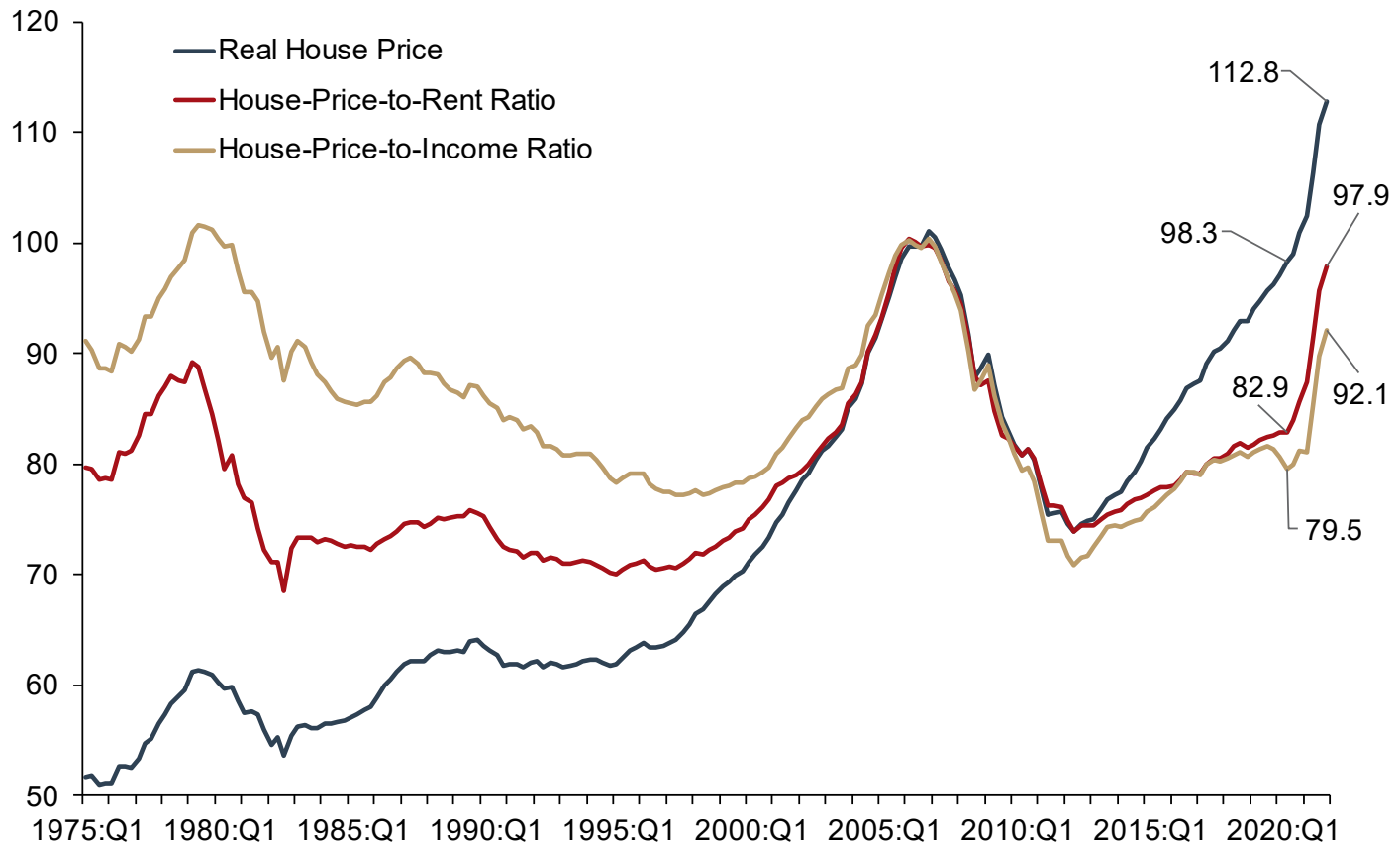
Year-over-year growth rates

SOURCES: International House Price Database; U.S. Bureau of Labor Statistics; Haver Analytics .

REAL HOUSE PRICES ACCELERATED DURING THE PANDEMIC, ARE AT A HISTORICALLY HIGH LEVEL

US Real House Prices, House-Price-to-Rent Ratio and House-Price-to-Income Ratio
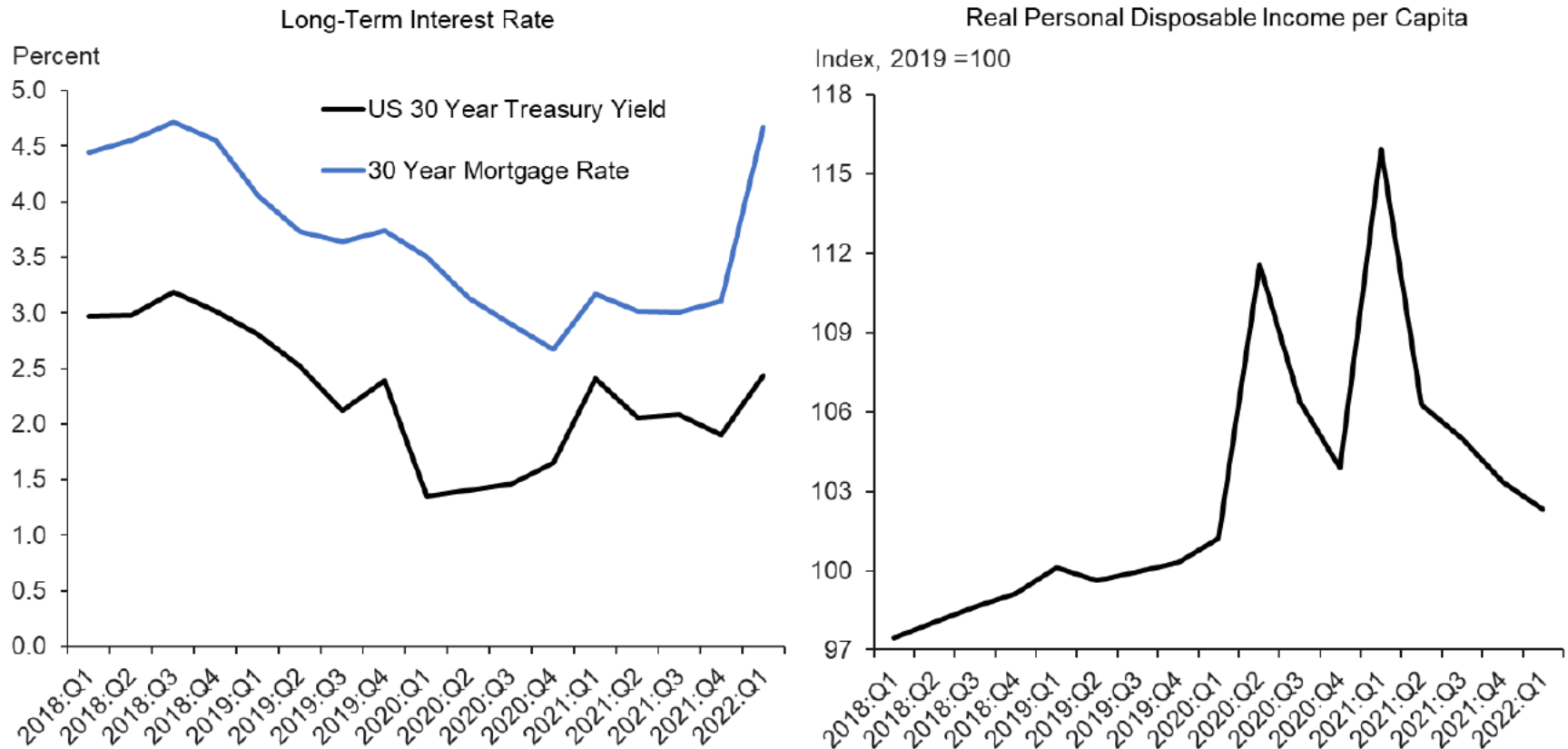

Index, 2006 = 100

SOURCES: International House Price Database; U.S. Bureau of Labor Statistics; Haver Analytics.

HOUSING MARKET HANGOVER?

Housing Demand Drivers Boosted by Low Rates, Fiscal Stimulus During 2020-2021

Long-Term Interest Rate

Percent

— US 30 Year Treasury Yield
— 30 Year Mortgage Rate

Real Personal Disposable Income per Capita

Index, 2019 =100

SOURCES: Federal Reserve Board of Govenors; Freddie Mac; U.S. Bureau of Economic Analysis; U.S. Bureau of Labor Statistics.

Savings

HOUSING COMPLETIONS STALLED DURING THE PANDEMIC

Housing Supply Expanded Quickly, But Completions Still Lagging Since the Beginning of the Pandemic

Real Residential Investment

Index, 2019 =100

Housing Permits

Index, 2019 =100

- Housing Permits
- Housing Starts
- Housing Completions

SOURCES: U.S. Bureau of Economic Analysis; U.S. Census Bureau; authors' calculations.

III. EVIDENCE OF EXUBERANCE

III.A EXUBERANCE STATS

SIGNS OF EXUBERANCE IN U.S. HOUSING…

Exuberance in US Real House Prices, Price-to-Rent Ratio and Price-to-Income Ratio

SOURCES: International House Price Database; U.S. Bureau of Labor Statistics; Haver Analytics .

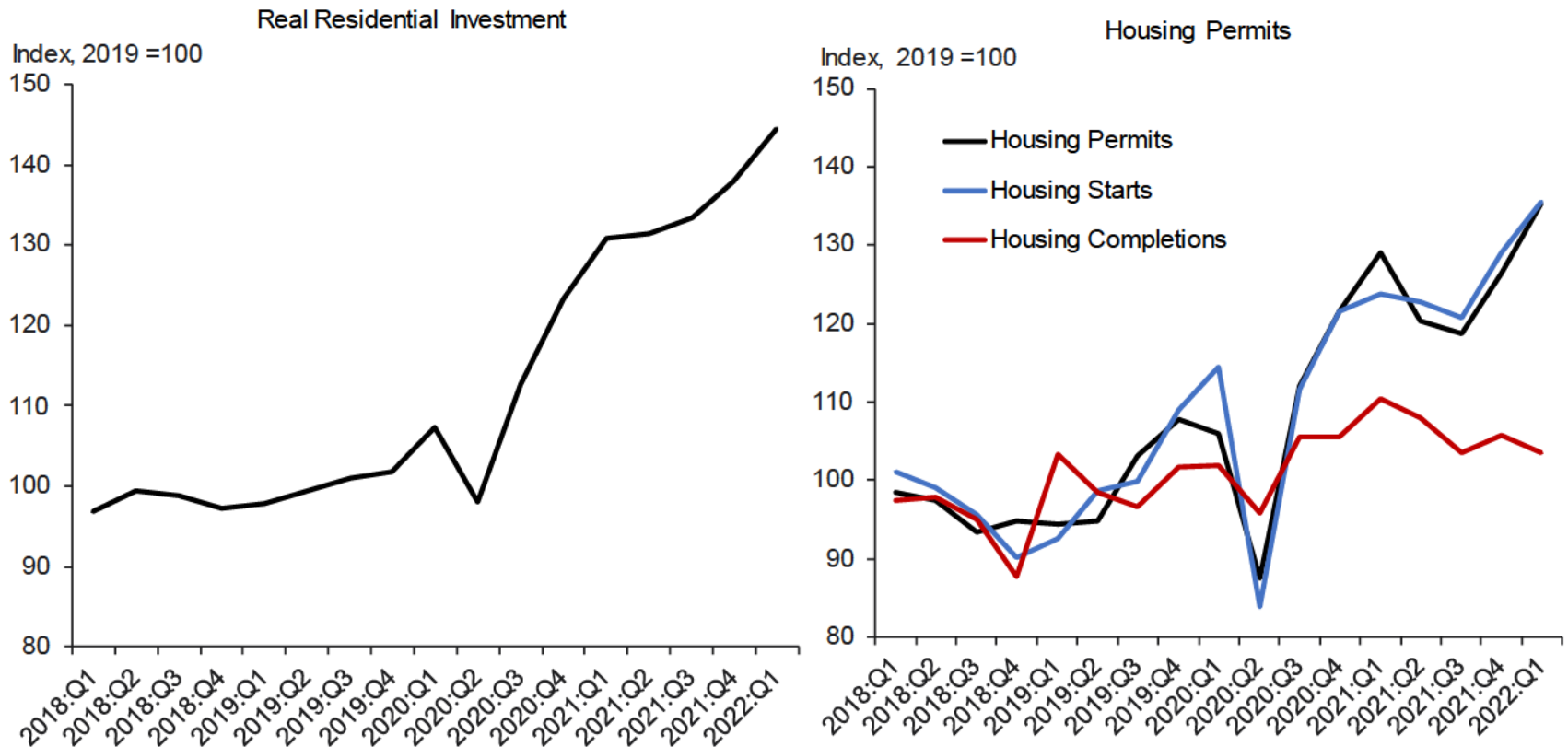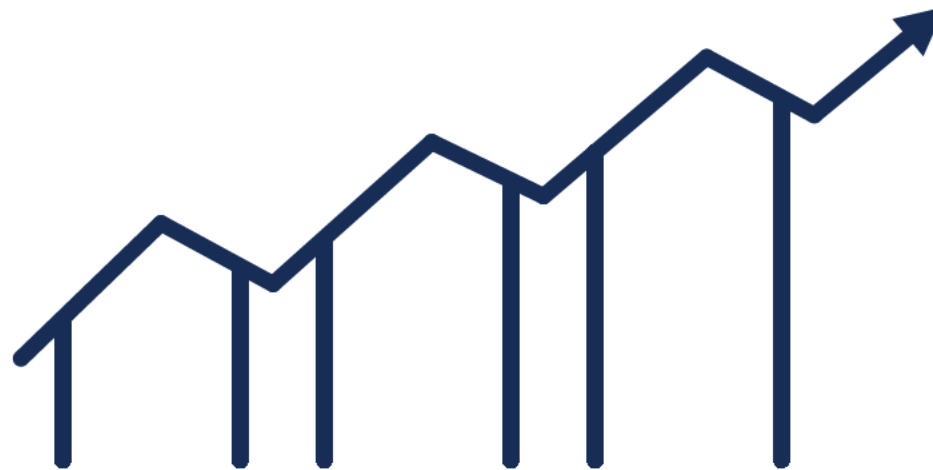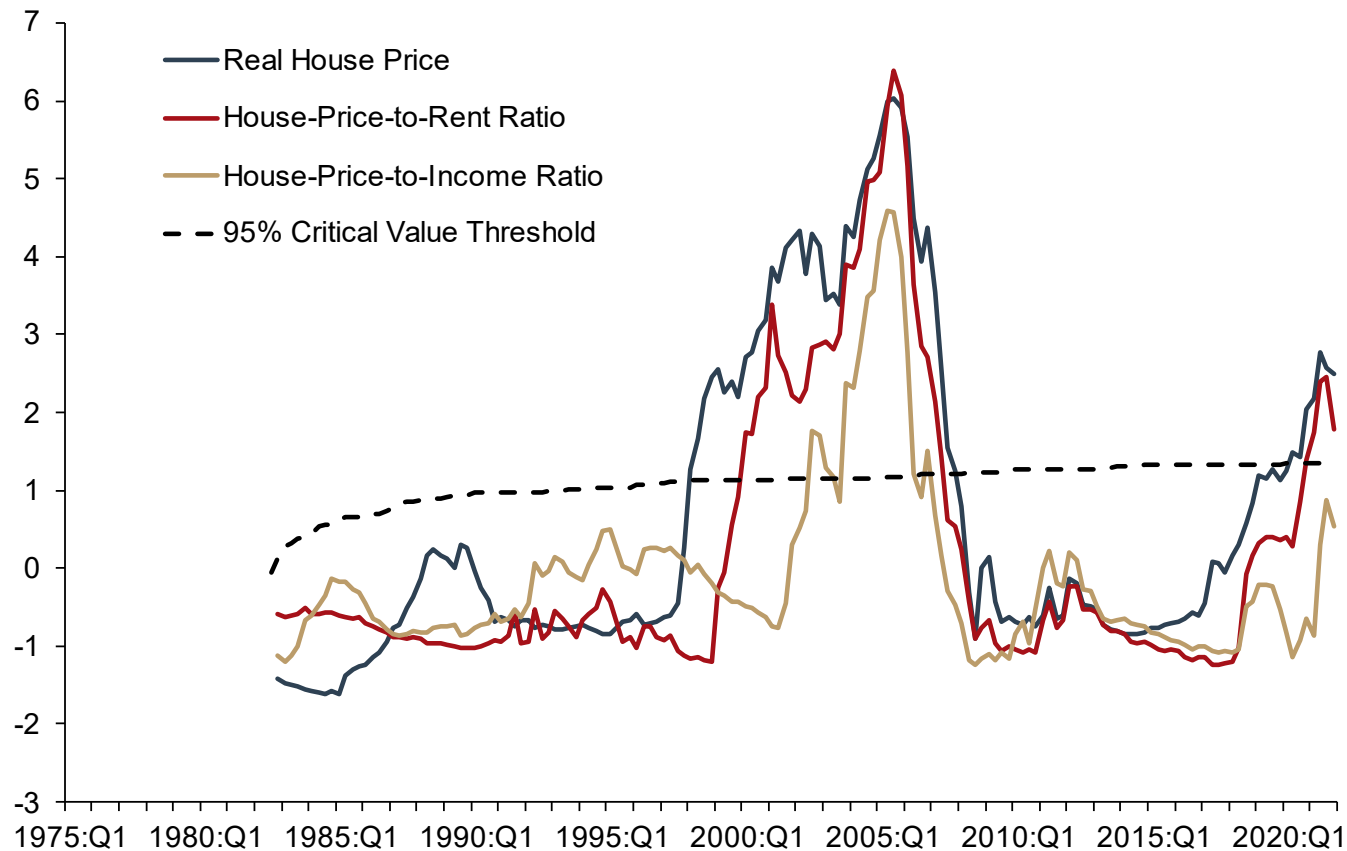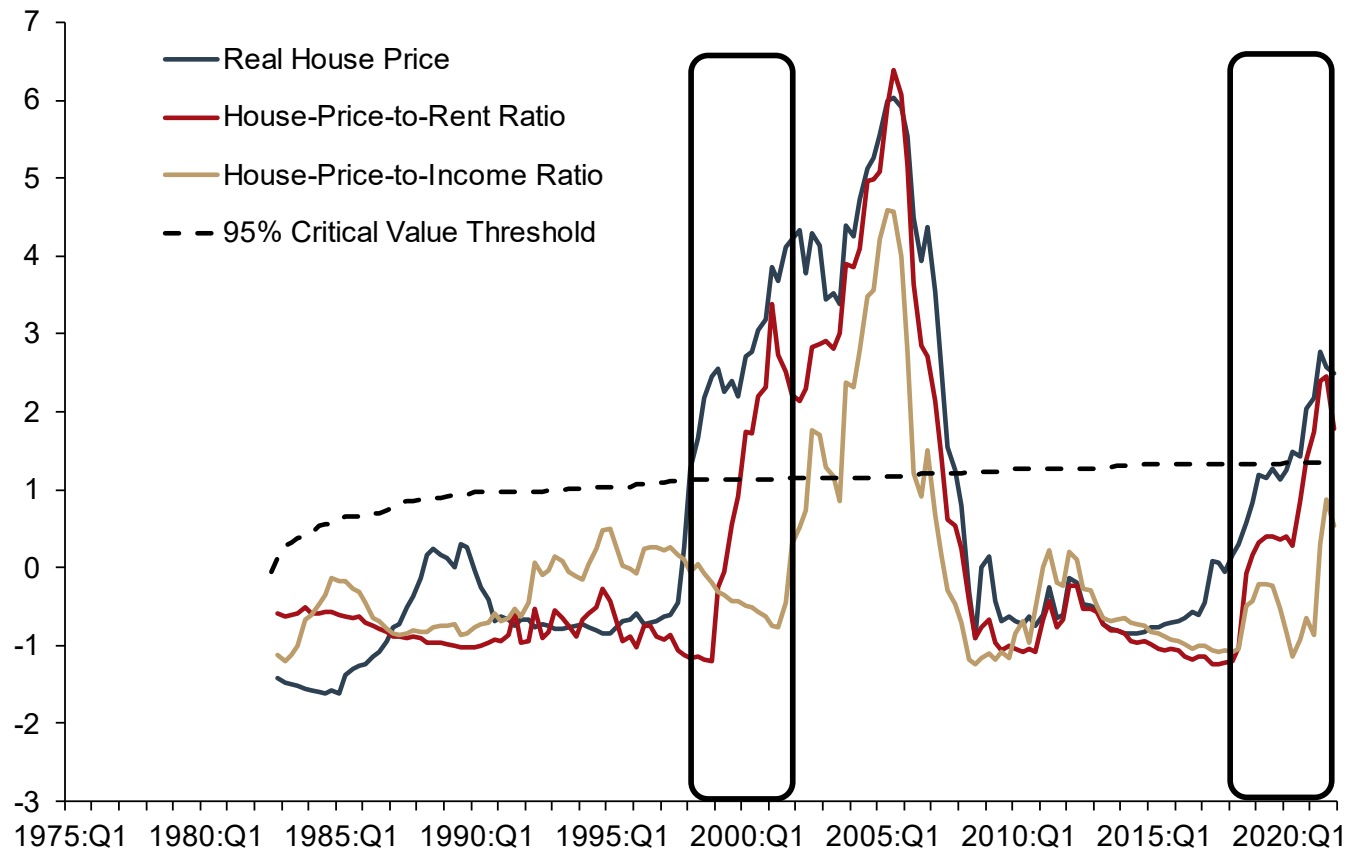# …ANALOGOUS TO THE EARLY SIGNS OF EXUBERANCE IN THE 2000s

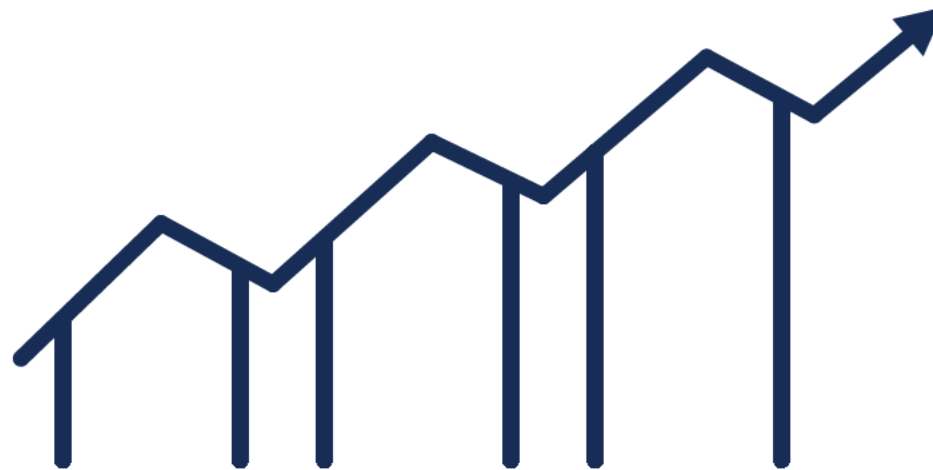**Exuberance in US Real House Prices, Price-to-Rent Ratio and Price-to-Income Ratio**

SOURCES: International House Price Database; U.S. Bureau of Labor Statistics; Haver Analytics .

GEOGRAPHIC HETEROGENEITY:
EVIDENCE OF EXUBERANCE ACROSS 18 MAJOR U.S. MSAs

SOURCES: Federal Housing Financing Agency; U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; authors' calculations.
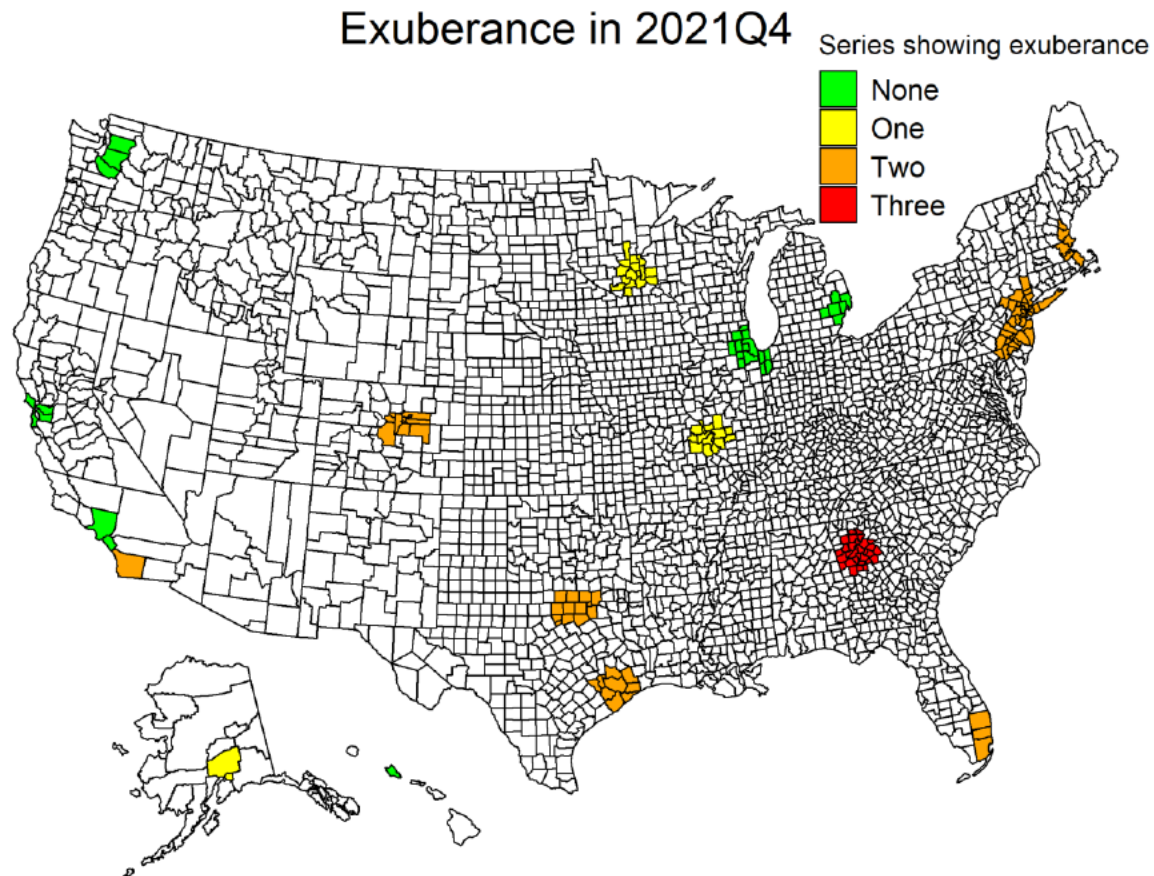
CONCLUDING REMARKS

CONCLUDING REMARKS

- **Housing can pose a risk to financial and macroeconomic stability**

  - due to its strong linkages to other sectors of the economy…

  - …and because it can be a source of vulnerabilities reaching into the broader economy

  - large misallocation of resources and efficiency losses can result from over-valuation (under-valuation) in housing markets

  - novel statistical toolkit to monitor housing markets in real-time (Dallas Fed's International House Price Database; International Housing Observatory)

- **The toolkit for surveillance and monitoring of housing booms and busts is still in development**

  - policy options and the effectiveness of policy actions may depend on data availability and timely evidence/insights

- **Evidence of exuberance to some extent predates the pandemic but has become more widespread since 2020 propagating across the East Coast and in the South**

  - U.S. "housing fever" signs display similarities with the early stages of the prior boom (in the early 2000s)

  - "housing fever" may have been triggered partly by fundamentals (housing demand getting ahead of housing supply during the pandemic)
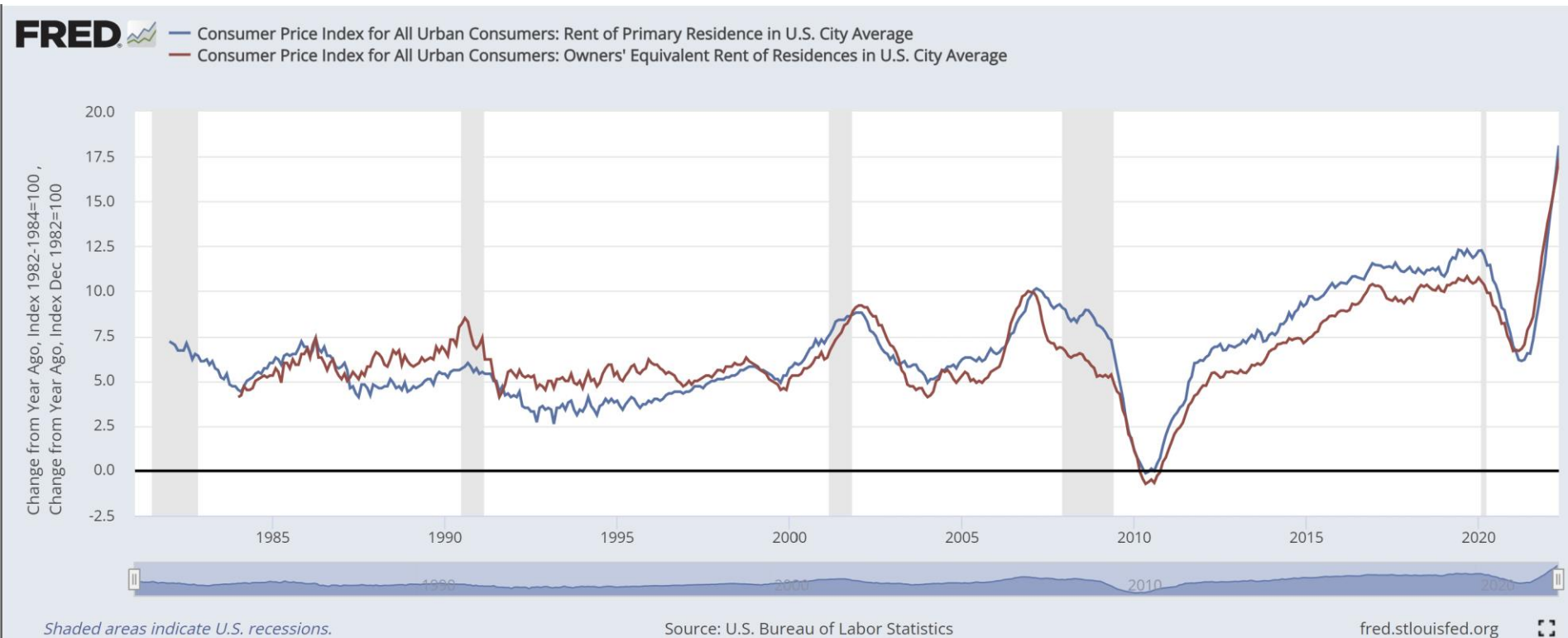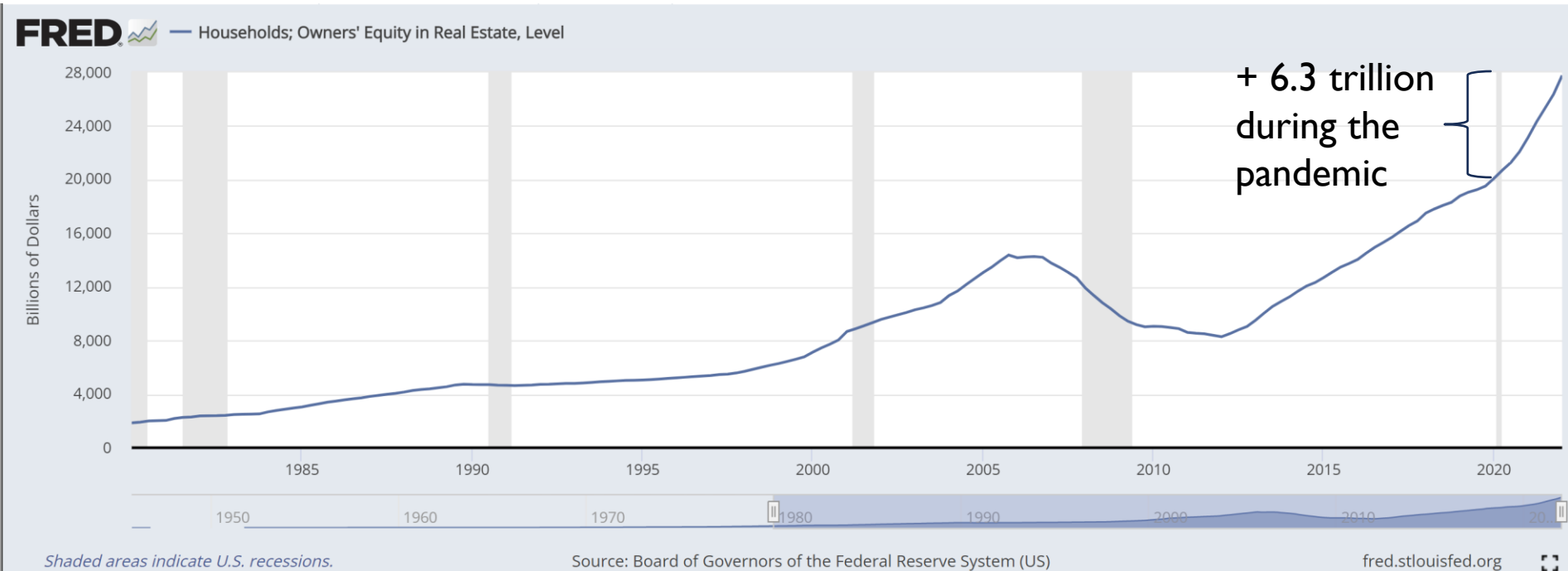
SHOULD WE WORRY ABOUT HOUSING?

THERE IS STILL MONETARY POLICY SPACE TO TIGHTEN
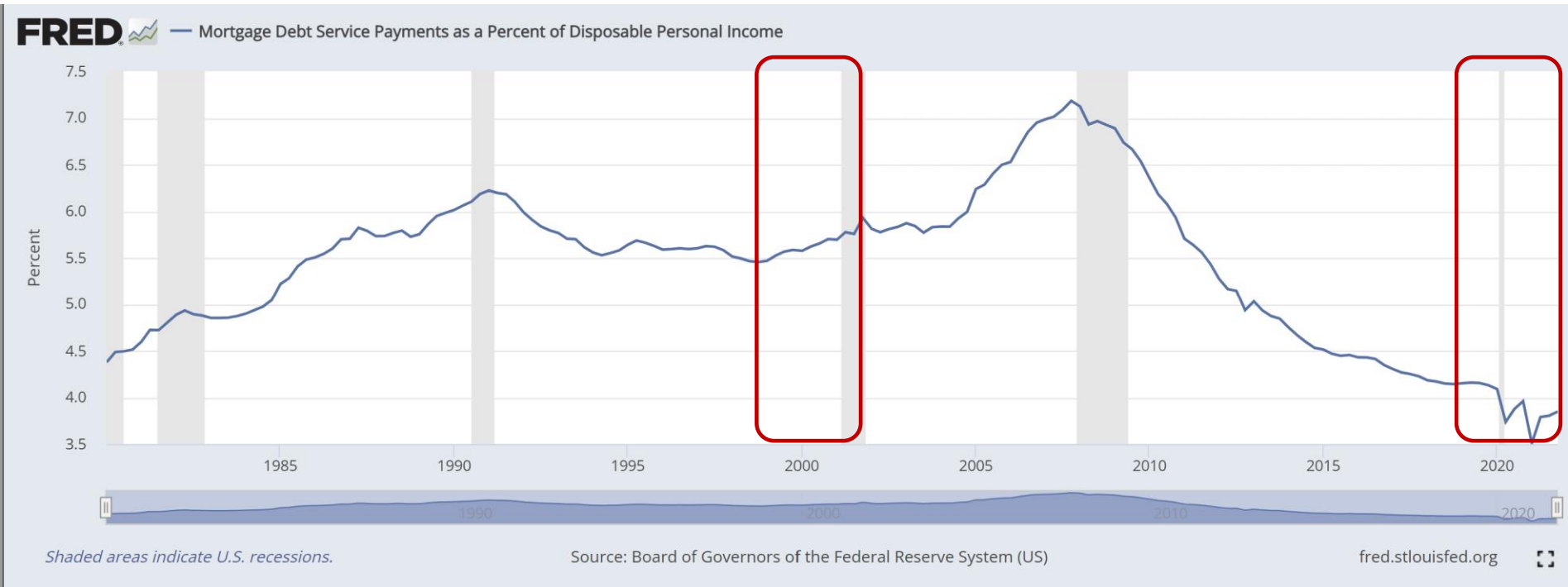
RISK SCENARIOS: HOUSING BOOM PUTS UPWARD PRESSURE ON INFLATION, WITH A LAG

RISK SCENARIOS: NEGATIVE WEALTH EFFECTS FROM A HOUSING CORRECTION

IS A HOUSING BUST INEVITABLE?

- **Will housing markets cool off or end up experiencing a major correction?**

  - not all housing booms—even if caused by a bubble—must end up with a correction or even a bust: the duration of the episode often correlates with the magnitude of the misalignment

    - house prices grew by 15% in real terms from 2020:Q2 till 2022:Q1 → presumably this puts an upper bound on any potential correction

    - some of that +15% surely is the result of fundamentals, and even of policy actions that supported income and lowered long-term rates during the pandemic while the housing supply was constrained → but entrenched high inflation may require much more tightening than currently anticipated and this could end up triggering a correction if mortgage servicing breaks the back of household finances

  - not comparable to the 2007–09 global financial crisis among other reasons because household balance sheets appear in better shape, little evidence of excessive borrowing

  - how supply catches up with demand over the next quarters and years as interest rates increase will likely influence how this episode of exuberance ("housing fever") ends

    - to the extent that a bubble has emerged, exuberance testing can provide information about the state of the market, **tame the expectations of continued large capital gains in housing**, and help reduce the danger of further prolonging the bubble

THANK YOU!!

International House Price Database
www.dallasfed.org/institute/houseprice/index.cfm

Where house prices live.

FOR QUESTIONS/FEEDBACK, CONTACT THE PRESENTER AT:

ENRIQUE MARTíNEZ GARCíA (FRB OF DALLAS)

ENRIQUE.MARTINEZ-GARCIA@DAL.FRB.ORG

FURTHER READINGS ON THE DATA AND THE INDICATORS MENTIONED IN THIS PRESENTATION:

"THROUGH THE ROOF" – WEBSITE ON HOUSING ECONOMICS (ENRIQUE MARTíNEZ-GARCíA)

"A CROSS-COUNTRY QUARTERLY DATABASE OF REAL HOUSE PRICES: A METHODOLOGICAL NOTE" (ADRIENNE MACK, ENRIQUE MARTíNEZ-GARCíA, AND VALERIE GROSSMAN), GLOBALIZATION AND MONETARY POLICY INSTITUTE WORKING PAPER NO. 99, DECEMBER 2011 (REVISED: JANUARY 2018)

"EPISODES OF EXUBERANCE IN HOUSING MARKETS: IN SEARCH OF THE SMOKING GUN" (EFTHYMIOS PAVLIDIS, ALISA YUSUPOVA, IVAN PAYA, DAVID PEEL, ADRIENNE MACK, ENRIQUE MARTíNEZ -GARCíA, AND VALERIE GROSSMAN), *THE JOURNAL OF REAL ESTATE FINANCE AND ECONOMICS,* VOL. 53(4), PP. 419-449, 2016.

"REAL-TIME MARKET MONITORING FINDS SIGNS OF BREWING U.S. HOUSING BUBBLE" (JAROD COULTER, VALERIE GROSSMAN, ENRIQUE MARTíNEZ-GARCíA, PETER C.B. PHILLIPS AND SHUPING SHI), DALLAS FED ECONOMICS BLOG, MARCH 29, 2022

APPENDIX

MILDLY EXPLOSIVE BEHAVIOR

- Time series that display boom-bust episodes due to a bubble display two important properties

  - they are nonlinear (because they burst)

  - they are (mildly) explosive during their boom or exuberant phase

- **Property 1**: The effects of aggregating nonlinear processes (or linear with nonlinear processes) are, in general, unknown (Granger and Lee (1999))

- **Property 2**: The combination of explosive processes with other explosive, unit root, and/or stationary processes tends to be explosive

- **An often-overlooked issue is the nexus between aggregation and the SADF/GSADF procedures to detect mildly explosive behavior**

  - the panel GSADF test of Pavlidis et al. (2016) establishes an empirical benchmark that incorporates the cross-sectional variation and heterogeneity of the disaggregated data

  - Pavlidis et al. (2018) examine the role of aggregation by conducting two large simulation experiments based on real house price data

  - power loss due to aggregation, but less so for GSADF than SADF

Explosive Roots

MILDLY EXPLOSIVE ROOTS

- **Phillips and Magdalinos (2007a, 2007b):** define a mildly explosive root as (where T=sample size)

$$y_t = \delta_T y_{t-1} + \epsilon_t, \ \ \epsilon_t \sim i.i.d.(0, \sigma^2), \ \delta_T = 1 + \frac{c}{T^\alpha}, \alpha \in (0,1)$$

  - which can be re-expressed as

$$\Delta y_t = \beta_T y_{t-1} + \epsilon_t, \ \ \epsilon_t \sim i.i.d.(0, \sigma^2) \ \ \ \beta_T = \delta_T - 1$$

- **Said and Dickey (1984):** incorporating serial correlation

$$\theta_{k+1}(B)y_t = \epsilon_t,$$

  - testing for a unit root can be performed as

$$\Delta y_t = \beta_T y_{t-1} + \sum_{j=1}^{k} \psi^j \Delta y_{t-j} + \epsilon_t, \ \ \epsilon_t \sim i.i.d.(0, \sigma^2),$$

$$\beta_T = -\theta_{k+1}(1) \text{ and } \psi^1 = -(\theta^2 + \theta^3 + \cdots + \theta^k + \theta^{k+1}),$$

$$\psi^2 = -(\theta^3 + \cdots + \theta^k + \theta^{k+1}), \dots, \ \psi^k = -(\theta^{k+1}).$$

Back

TESTING PROCEDURES

- The supremum ADF (SADF) of Phillips et al. (2011), the generalized SADF (GSADF) of Phillips et al. (2015), and even the panel GSADF test of Pavlidis et al. (2015)

  - GSADF recursive implementation

    - overcome the SADF's lack of power in identifying multiple episodes of periodically-collapsing exuberance within sample

    $$\Delta y_t = a_{r_1,r_2} + \beta_{r_1,r_2} y_{t-1} + \sum_{j=1}^{k} \psi_{r_1,r_2}^{j} \Delta y_{t-j} + \epsilon_t, \ \epsilon_t \sim i.i.d.\left(0, \sigma_{r_1,r_2}^2\right),$$

    - more power with aggregated data thanks to its flexibility
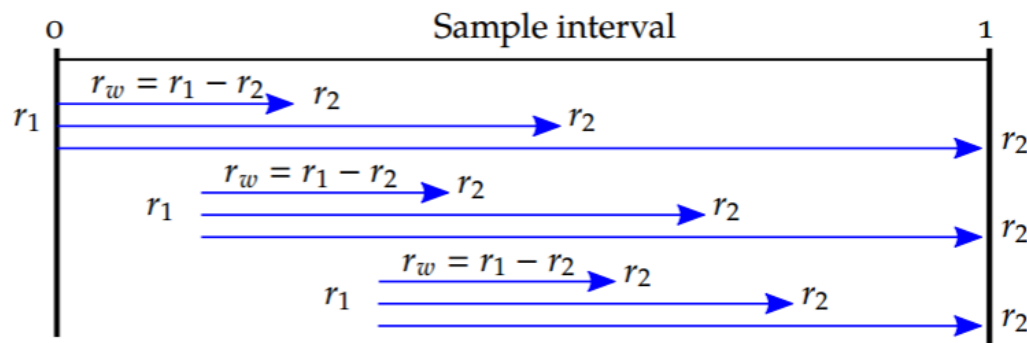
Panel

PANEL TECHNIQUE

- **Pavlidis et al. (2016)**: based on the panel data techniques developed by Im et al. (2003),

$$\Delta y_t^s = \alpha_{r_1,r_2}^s + \beta_{r_1,r_2}^s y_{t-1}^s + \sum_{j=1}^k \psi_{r_1,r_2}^{s,j} \Delta y_{t-j}^s + \epsilon_t^s, \ \epsilon_t^s \sim i.i.d. \left(0, \hat{\sigma}_{r_1,r_2}^2\right),$$

  - where the test is expressed as

$$H_0 : \beta_{r_1,r_2}^s = 0, \forall s,$$

$$H_1 : \beta_{r_1,r_2}^s > 0 \text{ for at least one } s.$$

  - The panel GSADF statistic is the average of the GSADF of each constituent series.

- The distribution of unit root tests is not invariant to cross-sectional dependence of the error terms → we adopt a sieve bootstrap approach to deal with that

Advantages

ADVANTAGES OF EACH PROCEDURE

| Test	Null Hypothesis	Alternative Hypothesis
ADF	Unit root	Mildly explosive
SADF	Unit root	Single collapsing episode
GSADF	Unit root	Multiple periodically collapsing episodes
Panel GSADF	Unit root (all)	At least one constituent series displays multiple periodically collapsing episodes

- Advantages for testing of GSADF/Panel GSADF

  - the recursive GSADF implementation is more flexible

  - panel GSADF relaxes the linear restriction and distributional assumptions that aggregation imposes on the testing hypothesis (allows ß to vary across constituent series)

Database

BUILDING A CONSISTENT DATASET

- **Dallas Fed International House Price Database**

  - 25 countries – more countries to be added in the future

  - starting data: 1975Q1; updated quarterly

  - benchmark: the FHFA quarterly price series for the U.S.

  - data is publicly available at: https://www.dallasfed.org/institute/houseprice.aspx

    - House prices (real and nominal)

    - Personal disposable income (real and nominal)

  - **Methodology**: Adrienne Mack and Enrique Martínez-García with Valerie Grossman (2011): "A Cross-Country Quarterly Database of Real House Prices: A Methodological Note." Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute Working Paper No. 99 (Revised: January 2019). http://www.dallasfed.org/assets/documents/institute/wpapers/2011/0099.pdf

HOUSING SAVINGS—SEARCHING FOR YIELD IN REAL ESTATE?

Most US Stimulus Appears to Have Been Saved During the Pandemic

Trillions of Dollars
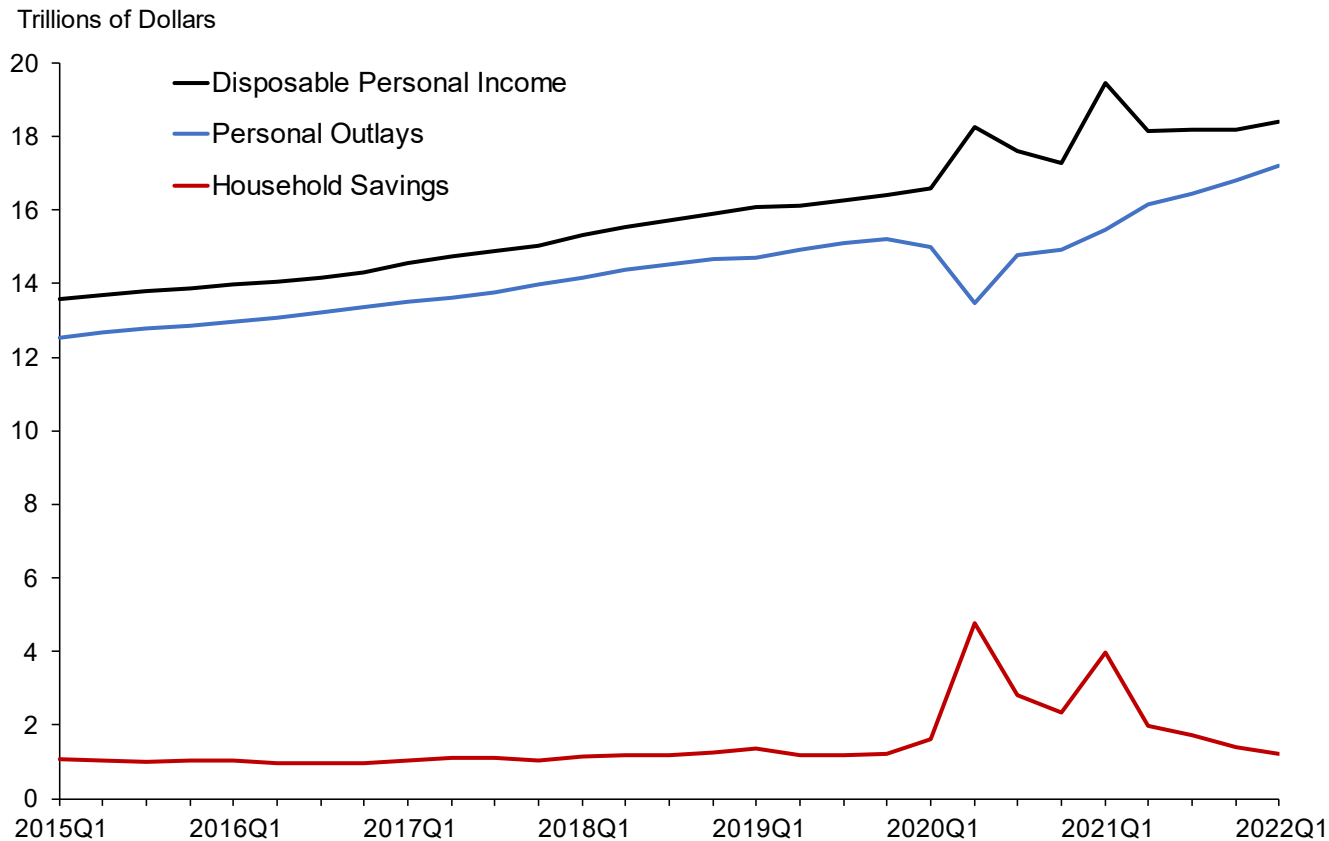
Source: U.S. Bureau of Economic Analysis.

Back