# Explosive Behaviour in Australian Housing Markets: Rational Bubbles or Not?

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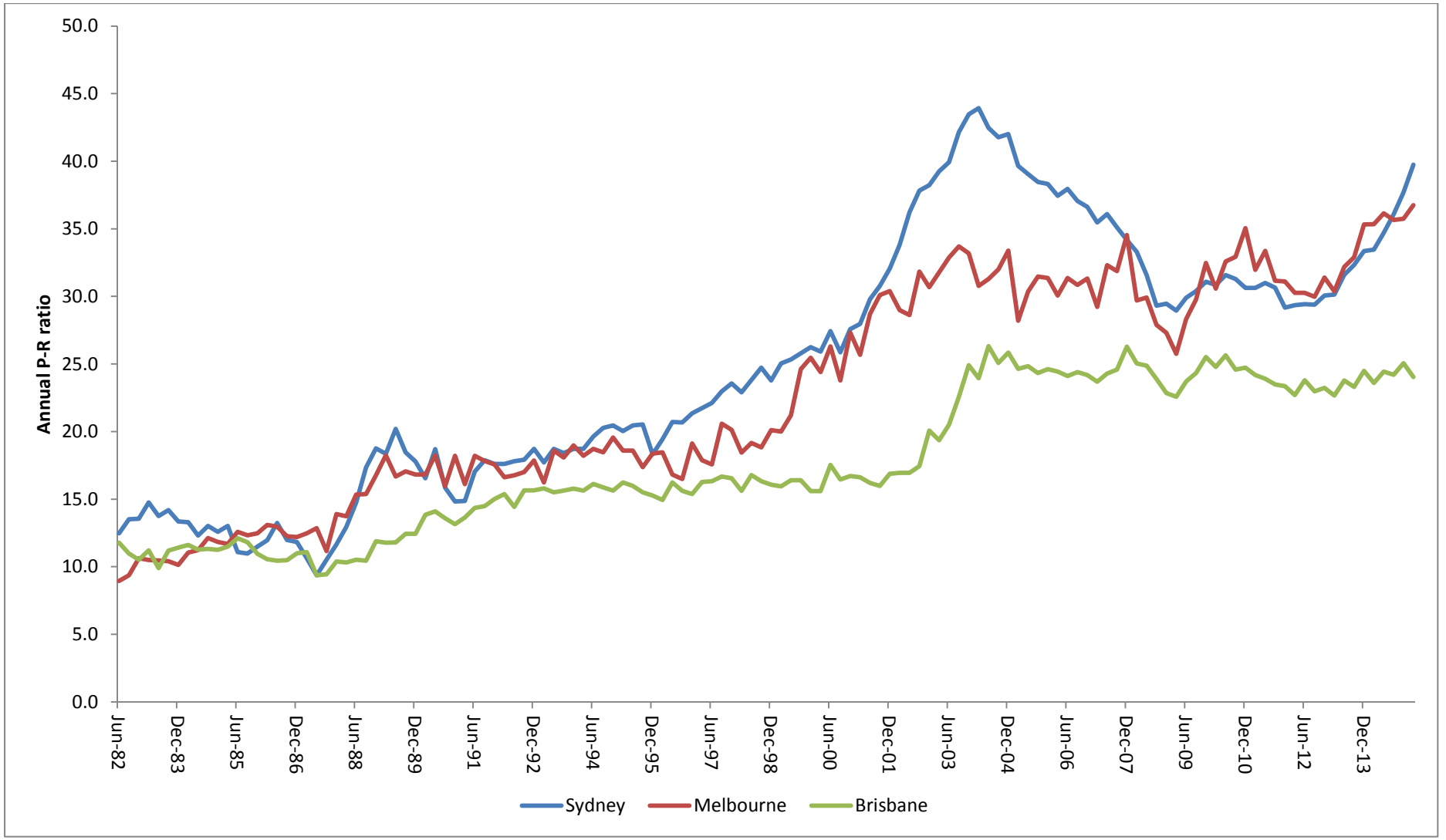
Real Estate Symposium
8 September, 2015

# (Median) Price-Rent Ratios for Sydney, Melbourne and Brisbane



**What is a Bubble?**

*Nasdaq definition (Campbell Harvey?)*

A market phenomenon characterized by ***surges*** in asset prices to levels significantly above the ***fundamental value*** of that asset. Bubbles are often hard to detect in real time because there is disagreement over the ***fundamental value*** of the asset.

Method that focuses on the “surges” element of this definition

## Definition of Housing Returns

$$R_{t+1}^{h} \equiv \frac{P_{t+1}^{h} + V_{t+1}^{h}}{P_{t}^{h}}$$

$P^h$ = house price

$V^h$ = net (or gross) rent

## User Cost Approach

$$R_{t+1}^h \equiv \frac{P_{t+1}^h + V_{t+1}^h}{P_t^h}$$

$$P_t^h R_{t+1}^h \equiv P_{t+1}^h + V_{t+1}^h$$

$$P_t^h [R_{t+1}^h - \frac{P_{t+1}^h}{P_t^h} + \delta] \equiv V_{t+1}^h - \delta P_t^h$$

$$P^h [r^h - \pi^h + \delta] = \tilde{V}^h$$

Fox and Tulip (2014)

## Present-Value Model for Price-Rent Ratio

$$R_{t+1}^{h} \equiv \frac{P_{t+1}^{h} + V_{t+1}^{h}}{P_{t}^{h}}$$

Take logs, a Taylor approximation and iterate forward

$$p_t^h - v_t^h = \frac{k}{1-\rho} + E_t\left[\sum_{j=0}^{\infty} \rho^j \left(\Delta v_{t+1+j}^h - r_{t+1+j}^h\right)\right] + b_t$$

$$E_t b_{t+1} = \frac{1}{\rho} b_t \qquad 0 < \rho < 1$$

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Fundamentals + Rational Bubble

**Rational Bubble is Explosive Process**

$$p_t^h - v_t^h = f_t^h + b_t$$

$$b_{t+1} = (1 + \alpha) b_t + \varepsilon_{t+1}$$

Cochrane (2001) "…it is hard to believe that price/dividend (rent) ratios can explode rather than revert back to their four-century average level of …"

**Periodically Collapsing Stochastic Bubble**

$$b_{t+1} = \begin{cases} \frac{1}{\rho\pi} b_t + \varepsilon_{t+1} & prob = \pi \\ \varepsilon_{t+1} & prob = (1-\pi) \end{cases}$$

$$E_t \varepsilon_{t+1} = 0$$

With prob = $1 - \pi$ : bubble bursts in any period

With prob = $\pi$ : bubble grows at explosive rate $\frac{1}{\rho\pi} > 1$

**Implication:** Asset prices exhibit periodic episodes of (marginally) explosive behaviour

## Tests for Explosive Roots

Phillips, Wu and Yu (2011) & Phillips, Shi and Yu (2013)

Basic Idea

$$\Delta y_t = \alpha + \gamma y_{t-1} + u_t$$

$H0: \gamma = 0$ Unit root

$H1: \gamma > 0$ Explosive root

Explosive roots are only temporary, so need to search through a series for explosive periods.

## Tests for Explosive Roots

*Single Bubble Episodes*

SADF: Pick an initial subsample and then compute right-tailed ADF test by adding an addition observation. Compare max of ADF sequence to simulated critical values.

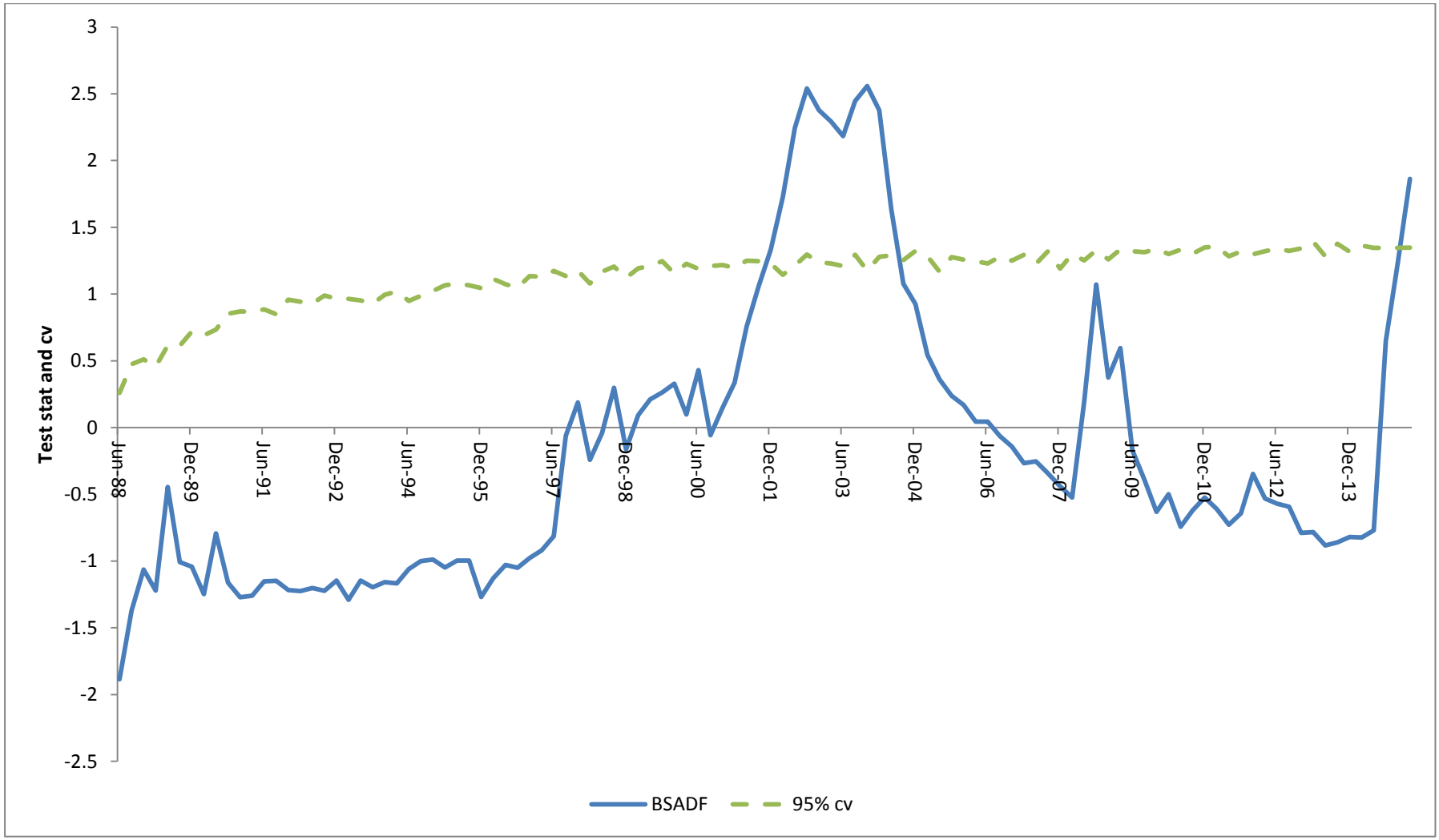
*Multiple Bubbles*

GSADF: Do above, but let start date for initial subsample move through the data as well. Find max {max ADF} and compare to simulated critical values.

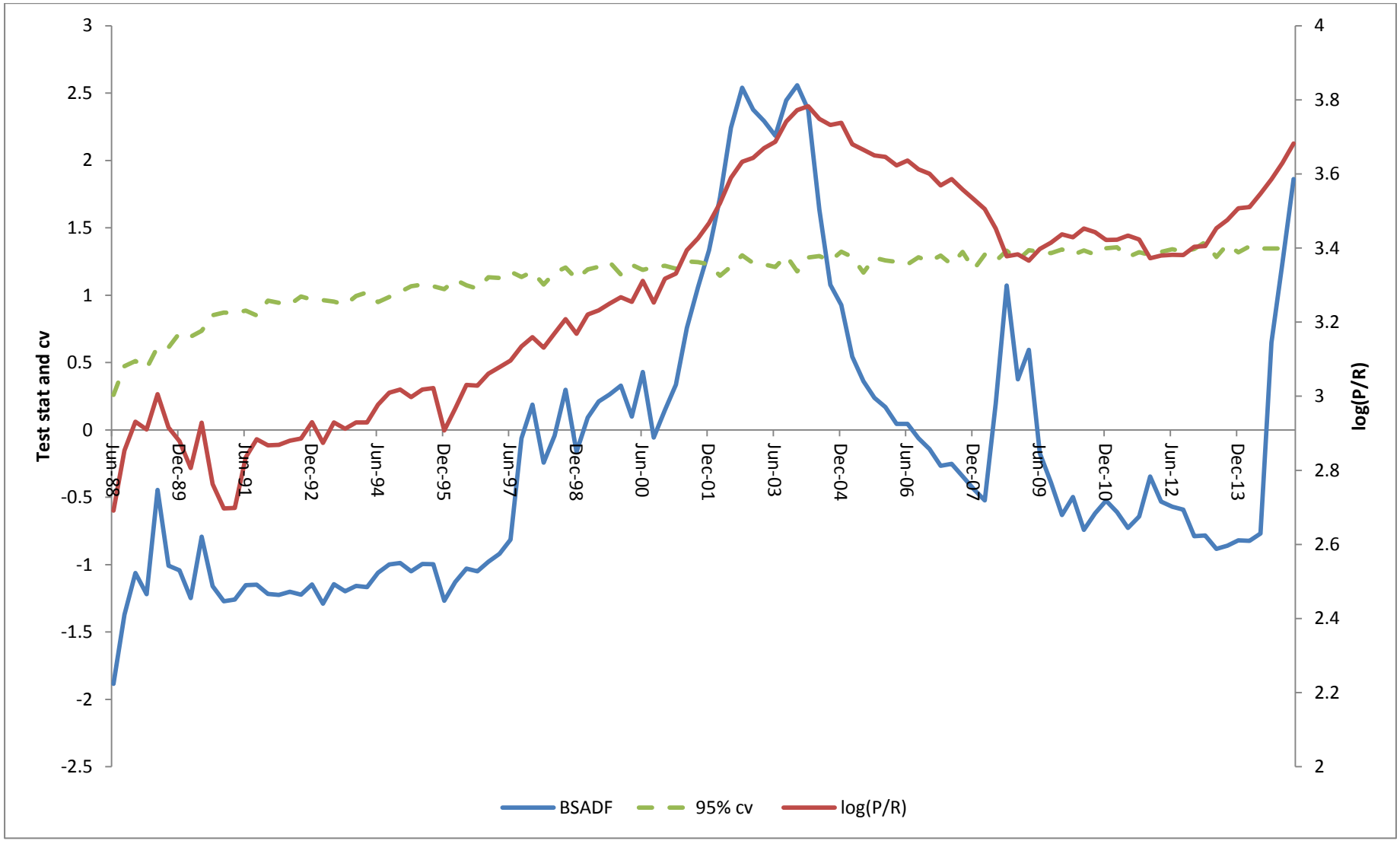
## Beginning and End Dates of Explosive Periods

BSADF: Plot the sequence of test statistics used in GSADF test against a sequence of simulated critical values.

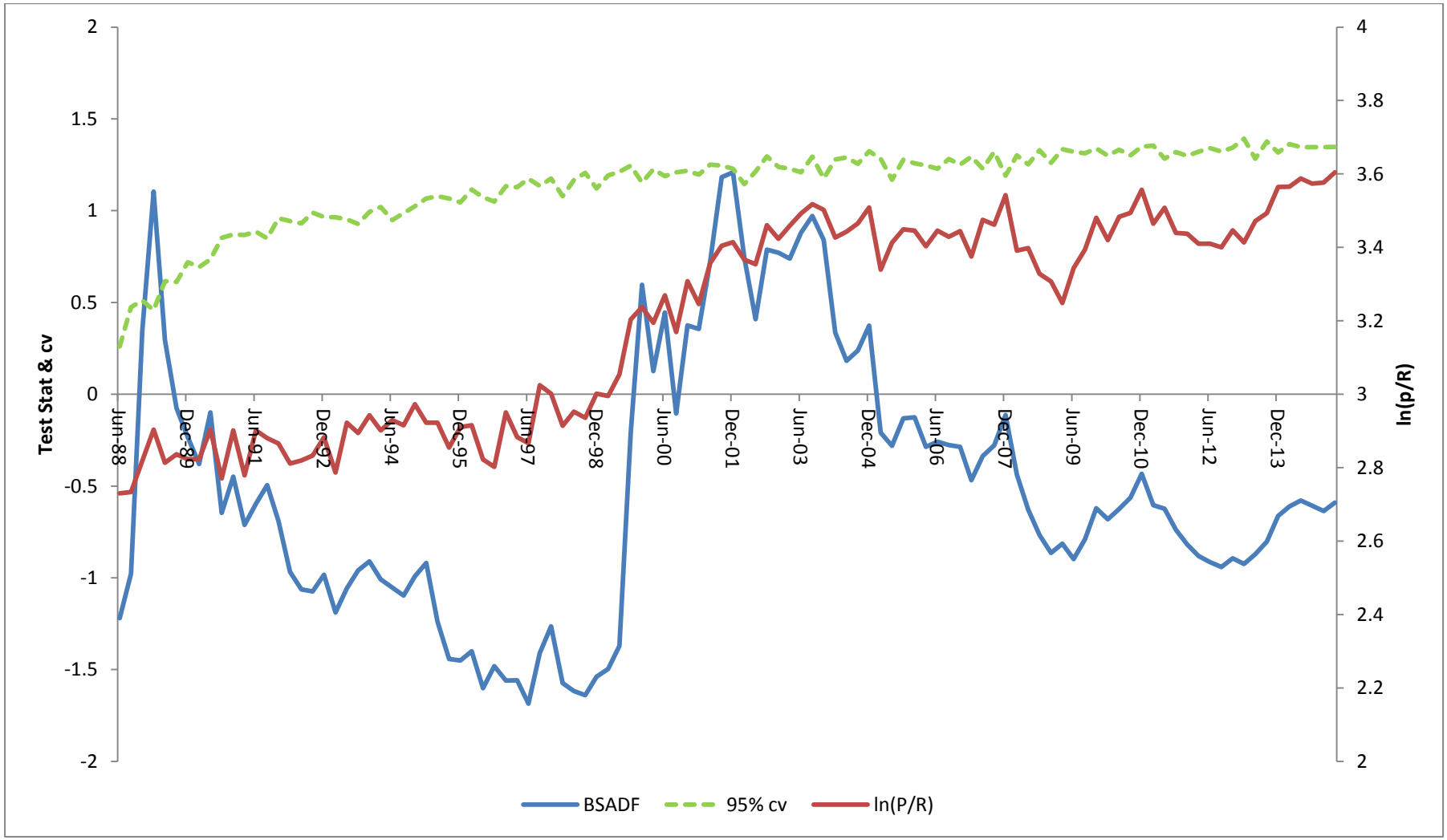
# BSADF Test Sequence for Sydney



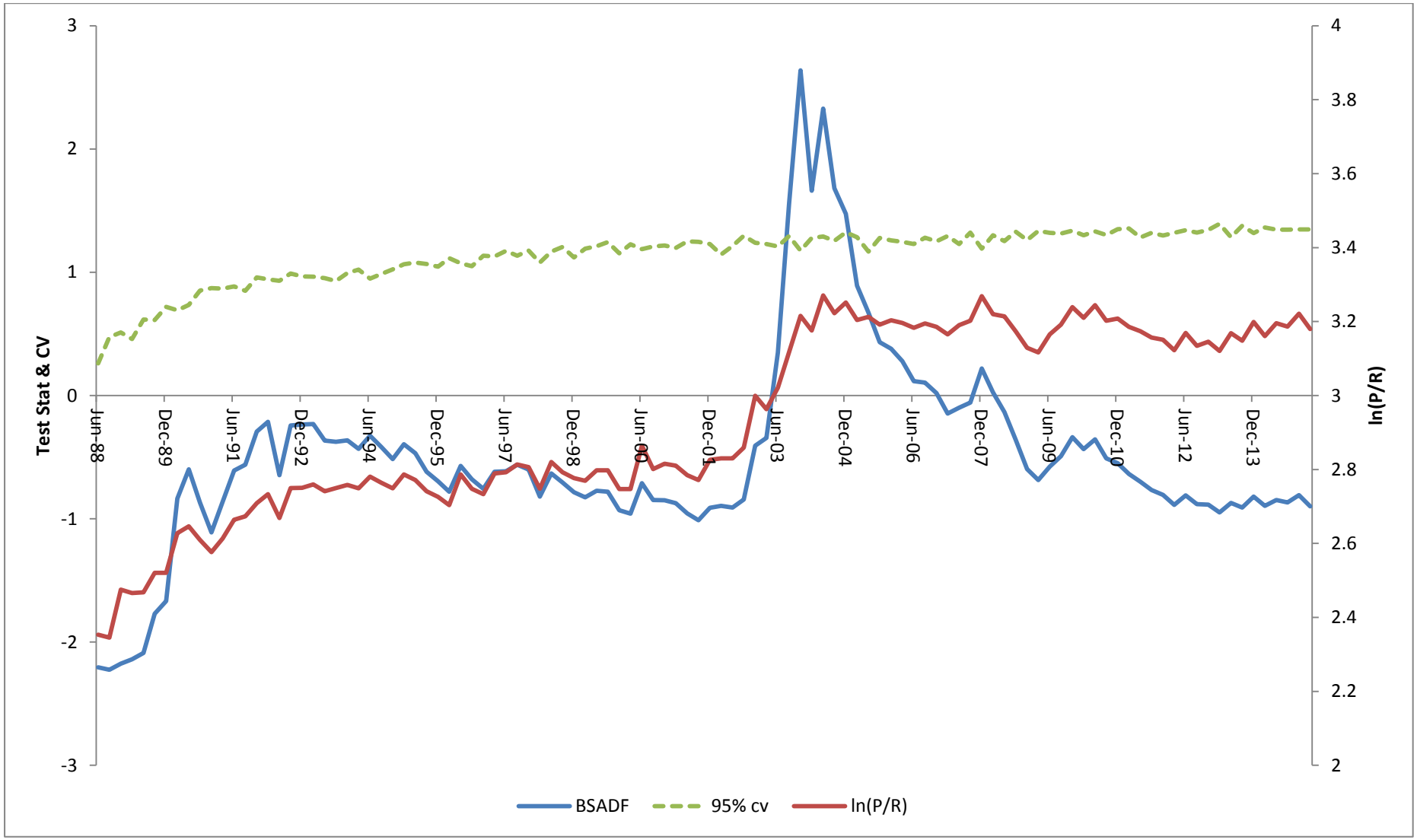
# BSADF Test Sequence for Sydney and Price-Rent Ratio



# BSADF Test Sequence for Melbourne



# BSADF Test Sequence for Brisbane



**Dates of Bubbles/Explosive Episodes**

| | *Start* | *End* | *Duration (quarters)* |
|---|---|---|---|
| Sydney | Dec 2001 | Jun 2004 | 11 |
| | Dec 2014 | ? | ? |
| Melbourne | Mar 1989 | Mar 1989 | 1 |
| Brisbane | Sep 2003 | Dec 2004 | 6 |

## Cross-City Differences in Price-Rent Ratios

Rise and fall in price-rent ratio

- Sydney
- Perth

One-time “permanent” rise in price-rent ratio

- Brisbane
- Adelaide
- Canberra

Non-explosive rise in price-rent ratio

- Melbourne

**Estimate Long-Run (Co-integrated) Model for Sydney and Brisbane**

$$p_t^h - v_t^h = f_t^h + b_t$$

$$I(1) = I(1) + (temp)explosive$$

Co-integration should hold outside of bubble episodes

Co-integration should fail over full sample

- Could fail due to structural break in fundamental relationship

## Fundamental Drivers of Sydney and Brisbane Price-Rent Ratio

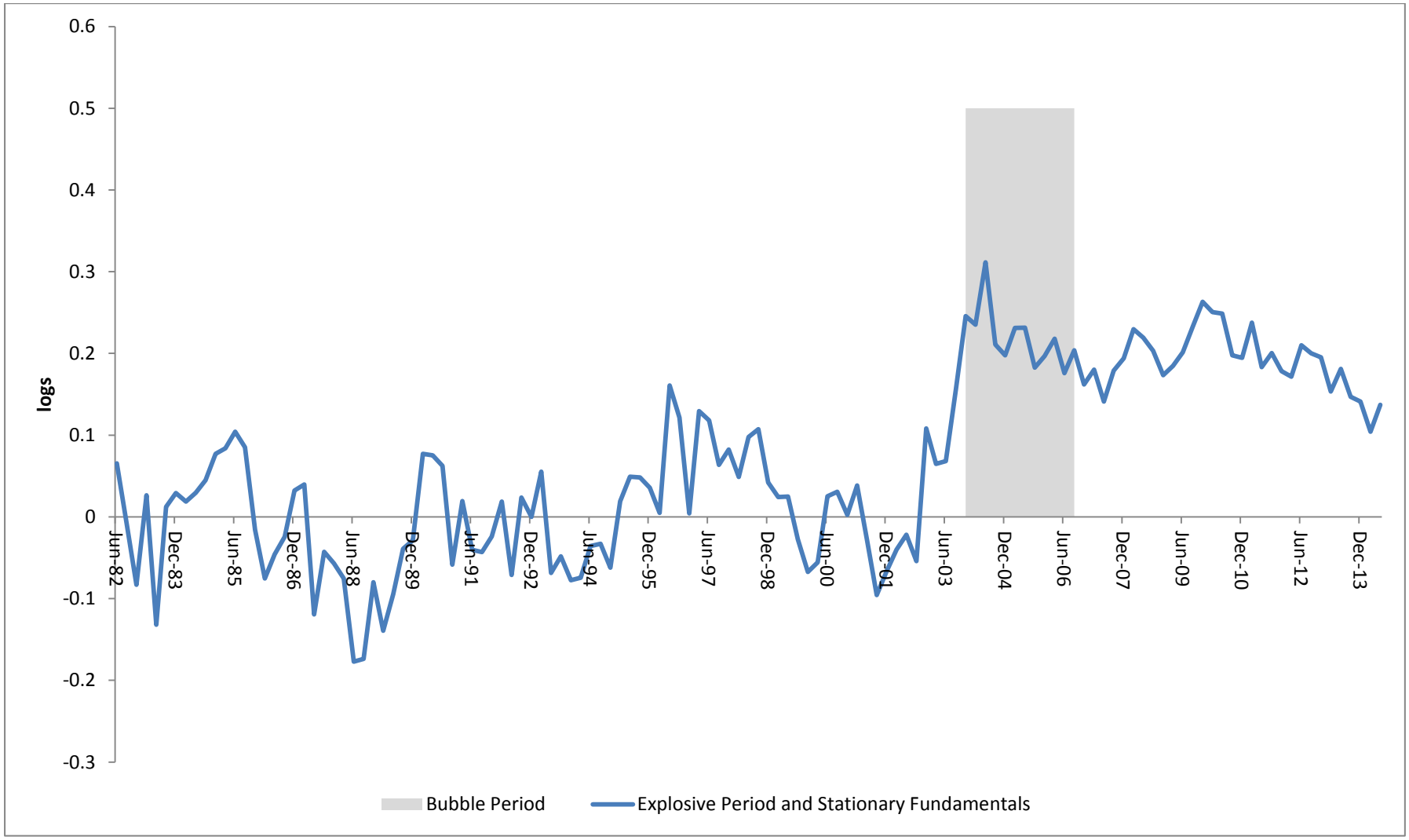
- (ex-post) real variable mortgage rate
- Melbourne price-rent ratio
- (State) Unemployment rate minus (Vic) Unemployment rate

## Long-Run Estimates

$$log(PR_t^i) = \beta_0^i + \beta_1^i\, log(1 + r_t^m) + \beta_2^i log(PR_t^{Mel}) + \beta_3^i\left(Un_t^i - Un_t^{Mel}\right) + u_t^i$$

| | **Brisbane** | **Sydney** |
|---|---|---|
| Sample | 82:2-03:2 | 82:2-01:3 |
| $\beta_1^i$ | -0.80 (0.52) | -2.33 (1.45) |
| $\beta_2^i$ | 0.48 (0.03) | 0.87 (0.13) |
| $\beta_3^i$ | -5.80 (0.88) | -6.57 (2.91) |
| EG-ADF | -4.7 | -3.89 |

# Full Sample Projection from CI Model for Brisbane



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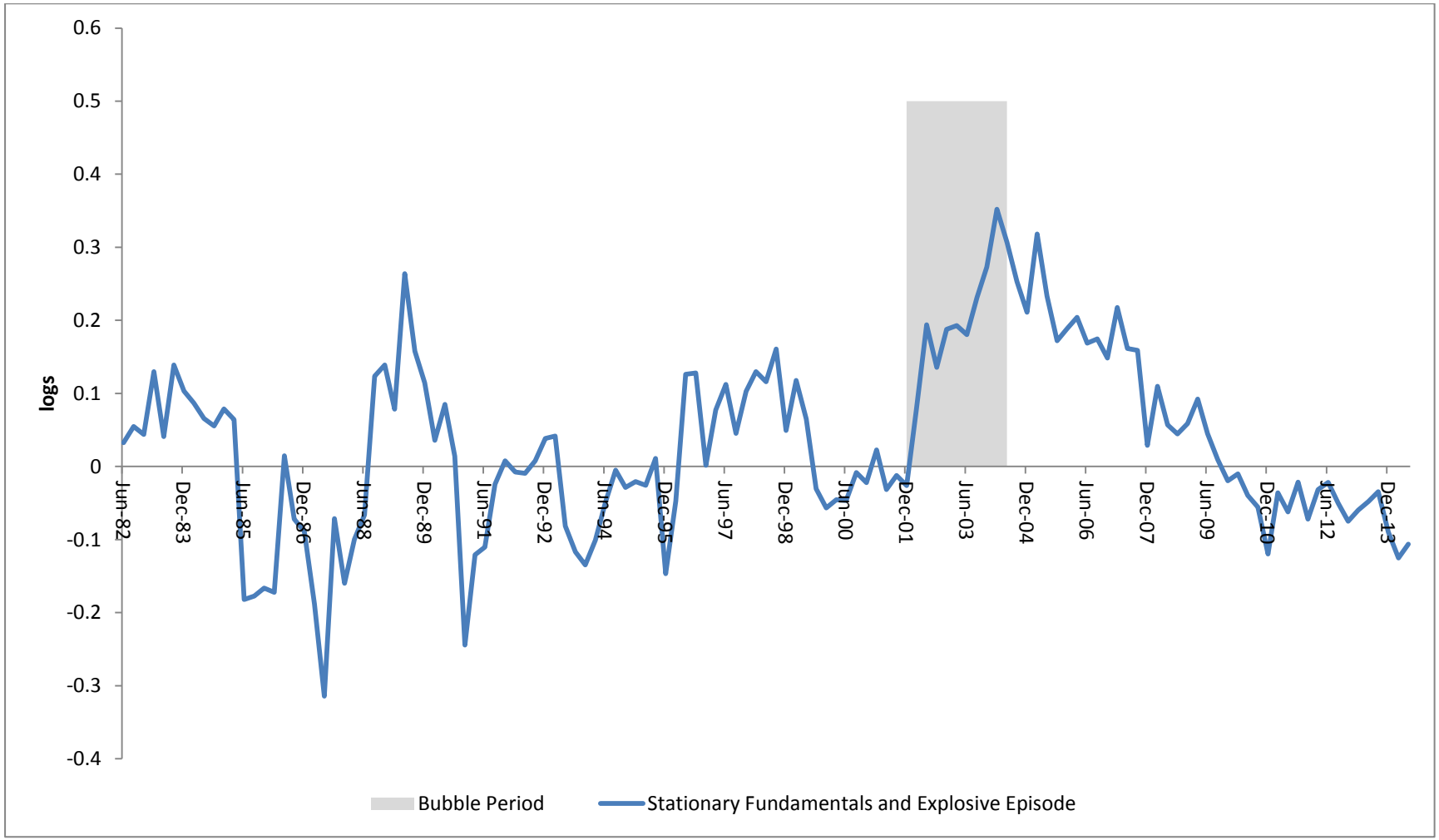


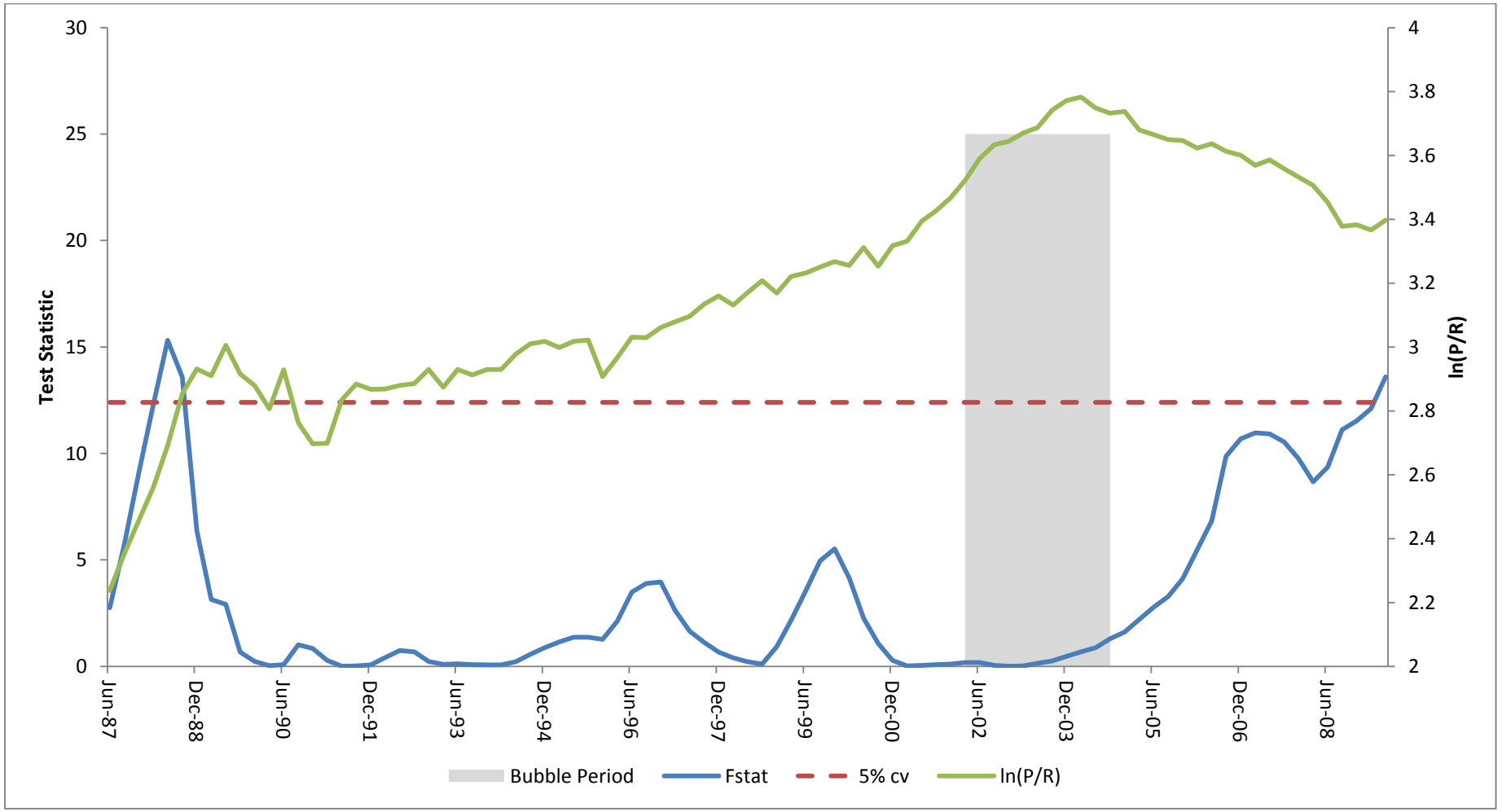
## Is it Parameter Instability?

$$log(PR_t^i) = \beta_0^i + \beta_1^i\, log(1 + r_t^m) + \beta_2^i log(PR_t^{Mel}) + \beta_3^i\left(Un_t^i - Un_t^{Mel}\right) + u_t^i$$

Hansen's Sup-F Stability Test for $\beta_0^i$ and $\beta_1^i$

Full-sample (aside from trimming)

# Stability Test for Sydney CI Relationship: Constant and Real Rate Coefficient



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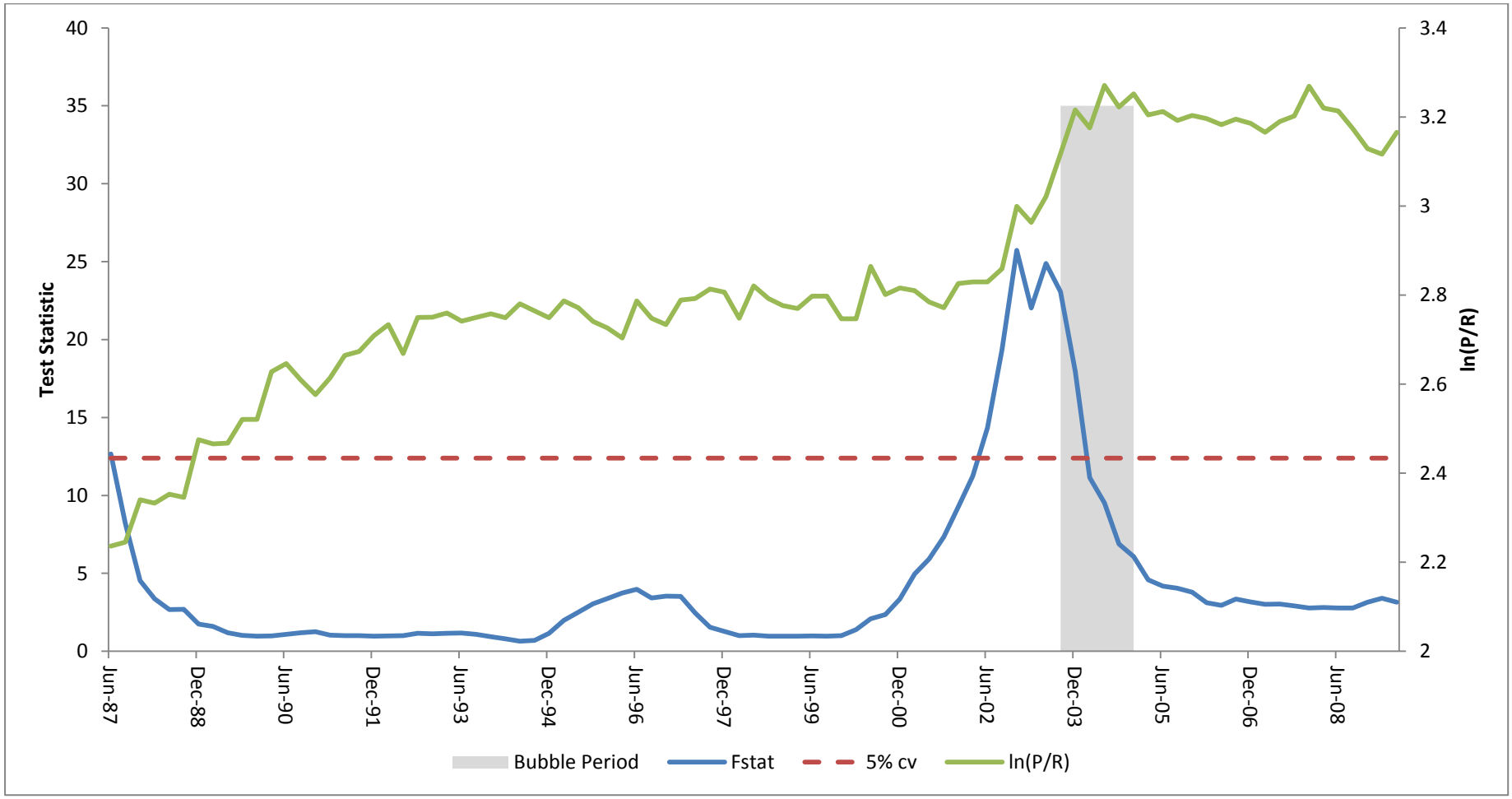

## How did Monetary Policy Respond to the Early 2000s Bubble?

Should central banks respond to asset price booms/bubbles?

- Lean against the wind

- Ignore and provide necessary liquidity in bust

# Cash Rate and Estimated Bubble Dates for Sydney and Perth