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

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(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

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

\( P^{h} = \text{house price} \)

\( V^{h} = \text{net (or gross) rent} \)
User Cost Approach

\[ R_{t+1}^h \equiv \frac{p_{t+1}^h + v_{t+1}^h}{p_t^h} \]

\[ p_t^h R_{t+1}^h \equiv p_{t+1}^h + v_{t+1}^h \]

\[ p_t^h [R_{t+1}^h - \frac{p_{t+1}^h}{p_t^h} + \delta] \equiv v_{t+1}^h - \delta p_t^h \]

\[ p_t^h [r^h - \pi^h + \delta] = \tilde{v}^h \]

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

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

\[ E_t b_{t+1} = \frac{1}{\rho} b_t \quad 0 < \rho < 1 \]
Present-Value Model for Price-Rent Ratio

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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

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

\[ E_t \varepsilon_{t+1} = 0 \]

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


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 \(\text{max ADF}\) 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

Test stat and cv

- Jun-88
- Dec-89
- Jun-91
- Dec-92
- Jun-94
- Dec-95
- Jun-97
- Dec-98
- Jun-00
- Dec-01
- Jun-03
- Dec-04
- Jun-06
- Dec-07
- Jun-09
- Dec-10
- Jun-12
- Dec-13

BSADF
95% cv
BSADF Test Sequence for Sydney and Price-Rent Ratio
BSADF Test Sequence for Melbourne

![Graph showing the BSADF Test Sequence for Melbourne with dates and values on the x-axis and y-axis. The graph includes lines for Test Stat & cv, ln(P/R), and 95% cv, with data points marked for specific dates between Jun-88 and Dec-13.]
BSADF Test Sequence for Brisbane
<table>
<thead>
<tr>
<th>City</th>
<th>Start</th>
<th>End</th>
<th>Duration (quarters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney</td>
<td>Dec 2001</td>
<td>Jun 2004</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Dec 2014</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Melbourne</td>
<td>Mar 1989</td>
<td>Mar 1989</td>
<td>1</td>
</tr>
<tr>
<td>Brisbane</td>
<td>Sep 2003</td>
<td>Dec 2004</td>
<td>6</td>
</tr>
</tbody>
</table>
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

\[ p_t^h - v_t^h = f_t^h + b_t \]

\[ I(1) = I(1) + (temp)\text{explosive} \]

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

\[ log(PR_t^i) = \beta_0^i + \beta_1^i \log(1 + r_t^m) + \beta_2^i \log(PR_t^{Mel}) + \beta_3^i (Un_t^i - Un_t^{Mel}) + u_t^i \]

<table>
<thead>
<tr>
<th>Sample</th>
<th>Brisbane</th>
<th>Sydney</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td>82:2-03:2</td>
<td>82:2-01:3</td>
</tr>
<tr>
<td>(\beta_1^i)</td>
<td>-0.80 (0.52)</td>
<td>-2.33 (1.45)</td>
</tr>
<tr>
<td>(\beta_2^i)</td>
<td>0.48 (0.03)</td>
<td>0.87 (0.13)</td>
</tr>
<tr>
<td>(\beta_3^i)</td>
<td>-5.80 (0.88)</td>
<td>-6.57 (2.91)</td>
</tr>
<tr>
<td>EG-ADF</td>
<td>-4.7</td>
<td>-3.89</td>
</tr>
</tbody>
</table>
Full Sample Projection from CI Model for Brisbane

- Bubble Period
- Explosive Period and Stationary Fundamentals
Full Sample Projection from CI Model for Sydney

The graph shows a time series plot with two distinct periods highlighted:

- **Bubble Period**: Shaded area from Jun-03 to Jun-07.
- **Stationary Fundamentals and Explosive Episode**: Blue line from Jun-82 to Jun-13.

The x-axis represents dates from Jun-82 to Jun-13, with specific months labeled at regular intervals. The y-axis shows the log values ranging from -0.4 to 0.6, indicating the variable being measured.

The graph visually illustrates the projection from the CI model for Sydney, emphasizing the contrast between a stationary period and an explosive episode.
Is it Parameter Instability?

$$\log(PR^i_t) = \beta_0^i + \beta_1^i \log(1 + r^m_t) + \beta_2^i \log(PR^{Mel}_t) + \beta_3^i(U_n^i - U_{n_m}^i) + u^i_t$$

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

![Graph showing the stability test for Sydney CI relationship with test statistic and ln(P/R) values over time.]
Stability Test for Brisbane CI Relationship: Constant and Real Rate Coefficient
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

[Graph showing cash rate and estimated bubble dates for Sydney and Perth, with indicator variable and percent axes.]