

# Predictability of output and inflation around asset price bubbles

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# Predictability of output growth and inflation

- Existing literature indicates significant large forecast instabilities across economic regimes – with a break date in early 80's (onset of *Great Moderation*).
- Implications for forecasting:
  - 1 Overall predictability of output growth and inflation by standard models increased (D'Agostino et al., 2006)
  - 2 Relative predictive ability of macro indicators and large scale models compared to RW or AR-models deteriorated since late 1970's (for output) and mid 1980's (for inflation) (Rossi & Sekhposyan, 2010)
- Not discussed: Forecast instabilities since Great Moderation

# Macro forecasts and asset price bubbles

Recent dot-com crash and GFC have renewed attention in the role of financial sector developments for real economy

- How do asset price booms and crashes relate to forecast breakdowns?
- Do asset price bubble indicators carry predictive content for macro variables?
- Policy implication: Should monetary policy “Lean-against-the-wind” of intensifying asset price cycles?
- First requirement: Real-time detectability of asset price bubbles and predictive content for CB’s target variables

# Research Questions

- 1 Are there times of significant surprises (breakdowns) in output growth and inflation forecasts since *Great Moderation*?
- 2 How do forecast breakdowns relate to asset price bubbles? Do breakdowns occur predominantly at bubble crashes only, or also at emergence?
- 3 Can forecasts of output growth and inflation be improved by including asset price bubble indicators?

# Three step procedure

- 1 Date asset price bubble emergence and collapse dates as determined by Phillips et al. (2013).
- 2 Relate dates of forecast breakdowns of large set of real-time models to bubble periods
  - Wald-test of Giacomini & Rossi (2009) for AR(X) forecasts.
- 3 Evaluate predictive accuracy and stability of forecast models augmented by bubble indicators
  - Pairwise comparisons of equal predictive accuracy
  - Forecast breakdown test as in 2)

# Asset price bubble periods

- Generalized sup ADF Test of Phillips et al. (2013): Test for explosive roots in price and dividend series ( $z_t = \{p_t, d_t\}$ )

$$z_t = \mu_z + \delta z_{t-1} + \sum_{j=1}^J \phi_j \Delta z_{t-j} + v_t, \quad v_t \stackrel{iid}{\sim} N(0, \sigma_v^2)$$

- Right-tailed recursive ADF tests of  $H_0 : \delta = 1$  vs.  $H_1 : \delta > 1$
- Test statistic for each margin  $\tau_2 = \tau_0, \tau_0 + 1, \dots, T$ :

$$BSADF_{\tau_2} = \sup_{\tau_1 \in [0, \tau_2 - \tau_0]} \{ADF_{\tau_1}^{\tau_2}\}$$

- Bubble emergence and collapse dates  $\tau_e$  and  $\tau_f$

$$\hat{\tau}_e = \inf_{\tau_2 \in [\tau_0, T]} \left\{ \tau_2 : BSADF_{\tau_2} > cv_{\alpha_T}^{bsadf}(\tau_2) \right\}$$

$$\hat{\tau}_f = \inf_{\tau_2 \in [\hat{\tau}_e, T]} \left\{ \tau_2 : BSADF_{\tau_2} < cv_{\alpha_T}^{bsadf}(\tau_2) \right\}$$

# Forecast specifications

- Direct, multistep AR(X) forecasts

$$y_{t+h} = \beta_0 + \beta_1(L)y_t + \beta_2(L)x_t + u_{t+h}, t = 1, 2, \dots, T$$

- $y_t = 1200 \log(Y_t / Y_{t-h}) / h$
- Lag selection by sequential BIC as in Rossi & Sekhposyan (2010)
- Single macroeconomic indicator  $x_t$
- All transformations (levels, 1st and 2nd-differences, percentage changes) of  $x_t$  evaluated individually
- Rolling window estimation ( $m = 120$  months)

# Data

- Target variables: U.S. IP growth and CPI inflation
- Real-time vintage data on real activity indicators (IP, CU, employment, hours worked)
- Unrevised data on financial indices (stock prices and dividends, house prices, interest rates, exchange rates, commodity prices)
- Total number of models: 227
- Sample: 1971M06-2014M10, forecast start: 1983M07 (first vintage of total capacity utilization)
- S&P500 price index and dividends, national house price index of Shiller (2005), real disposable income per capita



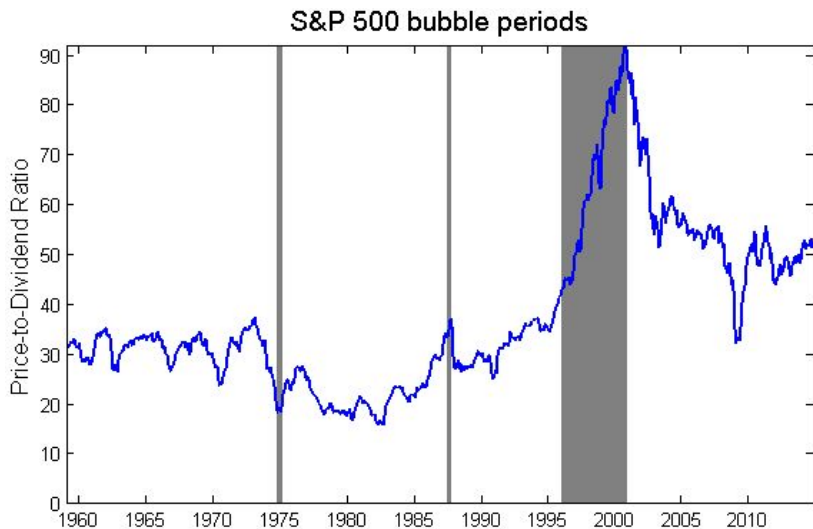
# Forecast Breakdown Test of Giacomini & Rossi (2009)

- Forecast breakdown defined as a deterioration in a model's out-of-sample forecast performance compared to in-sample fit
- *Surprise Loss*: difference between out-of-sample loss and average in-sample loss:  $SL_{t+h} = L_{t+h} - \bar{L}_t$ ,  $t = m, \dots, T - h$
- $SL$  likely to be serially correlated
- Dating of forecast breakdowns by autoregression of  $SL$

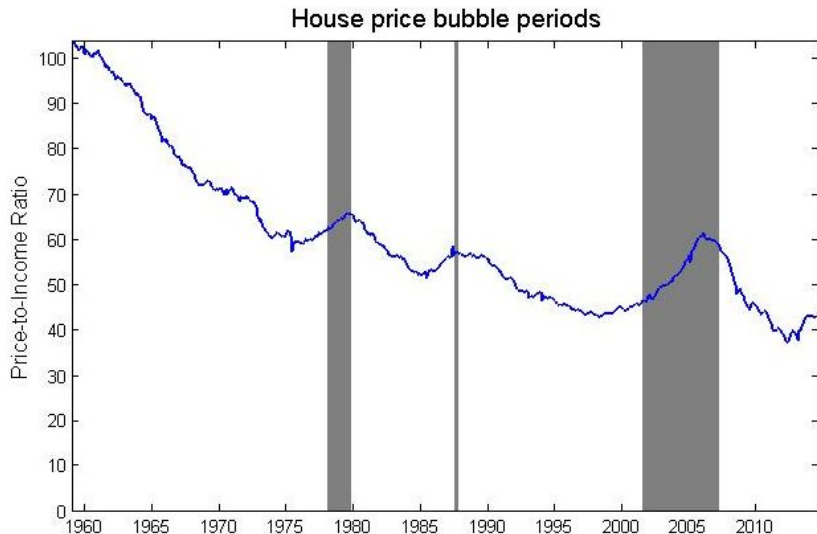
$$SL_{t+h} = Z'_t \delta + \varepsilon_{t+h}$$

- Breakdown if  $(1 - \alpha)\%$  CI around fitted values:  
 $(Z'_t \hat{\delta} - z_\alpha(Z'_t(\hat{\Omega}/n)Z_t)^{1/2}, +\infty) > 0$ ,  $z_\alpha$  is  $\alpha$ -quantile of  $N(0, 1)$ ,  $n$  is evaluation window length

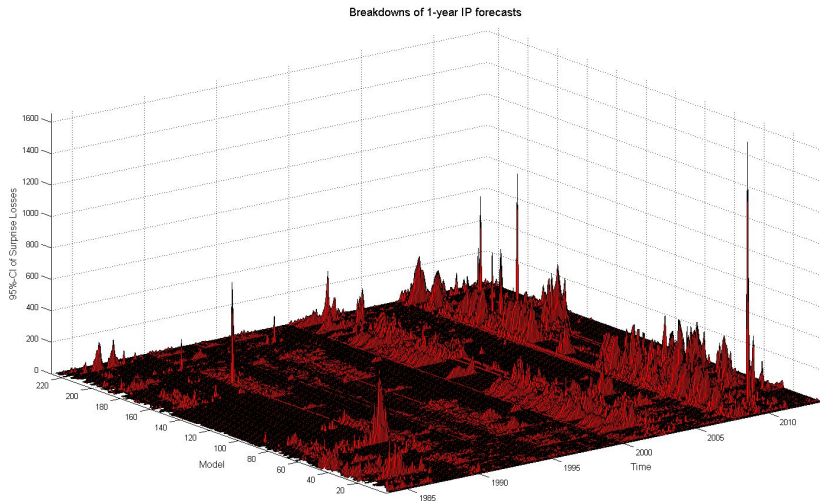
# Stock and housing bubbles



# Stock and housing bubbles



# Forecast breakdowns of 12-month forecasts for output



# Thank you.

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