Predictability of output and inflation around asset price bubbles

Benjamin Beckers, Dirk Ulbricht

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 ($z_t = \{p_t, d_t\}$)

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

- Right-tailed recursive ADF tests of $H_0 : \delta = 1$ vs. $H_1 : \delta > 1$
- Test statistic for each margin $\tau_2 = \tau_0, \tau_0 + 1, \ldots, T$: $BSADF_{\tau_2} = \sup_{\tau_1 \in [0, \tau_2 - \tau_0]} \left\{ ADF_{\tau_1}^{\tau_2} \right\}$
- Bubble emergence and collapse dates τ_e and τ_f

$$\hat{\tau}_e = \inf_{\tau 2 \in [\tau_0, T]} \left\{ \tau_2 : BSADF_{\tau_2} > cv_{\alpha_T}^{bsadf}(\tau_2) \right\}$$

$$\hat{r}_f = \inf_{\tau 2 \in [\hat{\tau}_e, T]} \left\{ \tau_2 : BSADF_{\tau_2} < cv_{\alpha_T}^{bsadf}(\tau_2) \right\}$$

Forecast specifications

- Direct, multistep AR(X) forecasts

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

- $y_t = 1200\log(Y_t/Y_{t-h})/h$
- 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

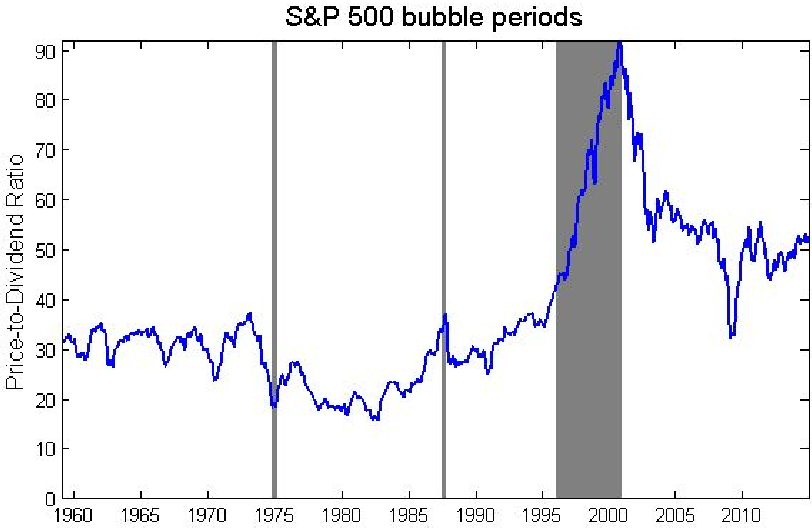
Forecast Breakdown Test of Giacomini & Rossi (2009)

- 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: $SL_{t+h} = L_{t+h} - \bar{L}_t,\ t = m, \ldots, T - h$
- SL likely to be serially correlated
- Dating of forecast breakdowns by autoregression of SL

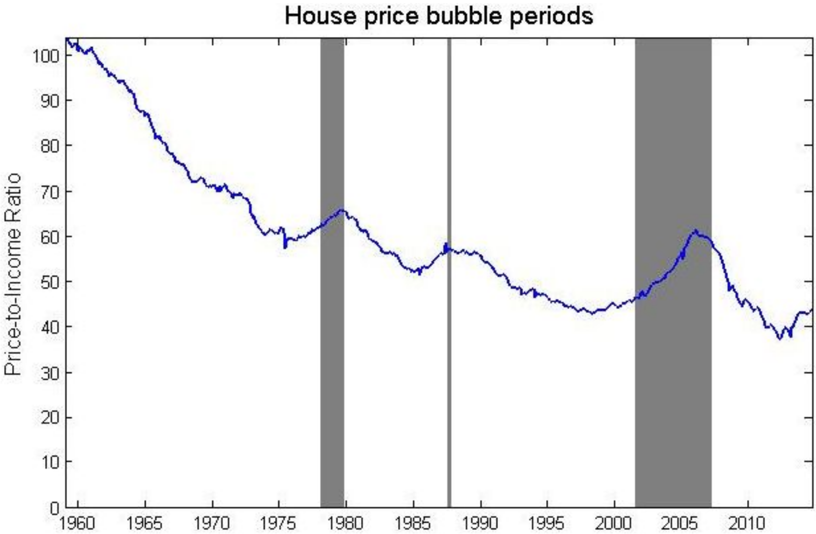
$$SL_{t+h} = Z_t' \delta + \varepsilon_{t+h}$$

- 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_α is α-quantile of $N(0, 1)$, n is evaluation window length

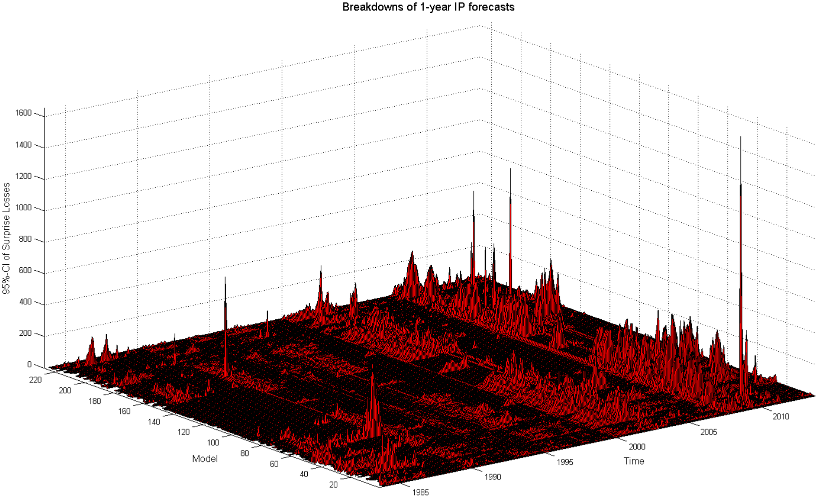
Stock and housing bubbles



Stock and housing bubbles



Forecast breakdowns of 12-month forecasts for output



Thank you.

DIW GRADUATE CENTER

DIW Berlin – Deutsches Institut
für Wirtschaftsforschung e.V.
Mohrenstraße 58, 10117 Berlin
www.diw.de

D'Agostino, A., Giannone, D., & Surico, P. (2006). *(Un)Predictability and Macroeconomic Stability*. Working Paper No 605, European Central Bank.

Giacomini, R. & Rossi, B. (2009). Detecting and Predicting Forecast Breakdowns. *Review of Economic Studies*, 76(2), 669–705.

Hansen, P. R., Lunde, A., & Nason, J. M. (2011). The Model Confidence Set. *Econometrica*, 79(2), 453–497.

Phillips, P. C., Shi, S.-P., & Yu, J. (2013). *Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500*. Cowles Foundation Discussion Papers 1914, Cowles Foundation for Research in Economics, Yale University.

Rossi, B. & Sekhposyan, T. (2010). Have economic models' forecasting performance for US output growth and inflation changed over time, and when? *International Journal of Forecasting*, 26(4), 808 – 835.

Shiller, R. J. (2005). *Irrational exuberance*. Princeton [u.a.]: Princeton [u.a.] : Princeton Univ. Press, 2. ed. edition. Includes bibliographical references and index.