Non-Linear Models
Exercices

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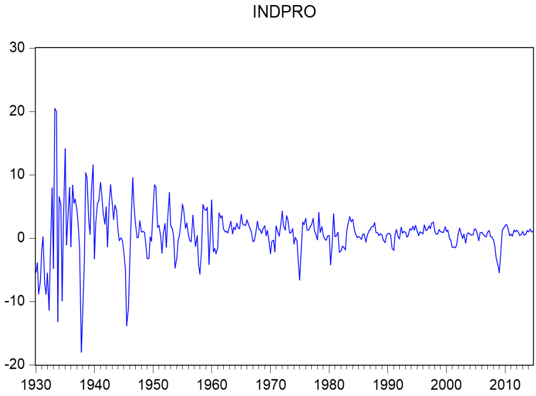
Plan

1. Quarterly IPI since 1919
   - Estimation of a SETAR
   - Estimation of a STAR
   - Estimation of a MS
2. Tracking the US business cycle with monthly variables

Data

- We are going to used data on quarterly growth rate of industrial production for the US from 1919q2 to 2014q4
- Data can be obtained from the FRED Database of the Federal Reserve of St Louis
- Get the data and plot them
- We use 1930q3-2000q1 as estimation period and 2000q2-2014q4 as forecasting period

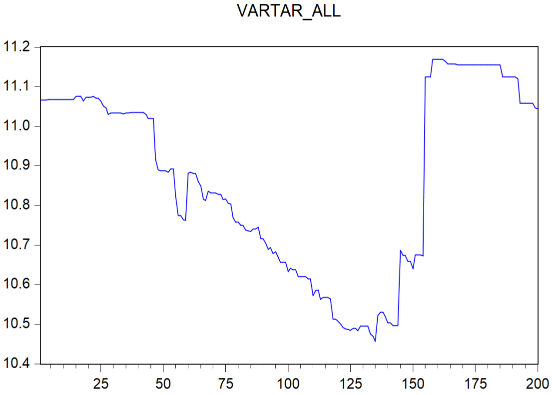
US industrial production



Estimation of a SETAR model

- First, test for the presence of non-linearity using the Hansen's Sup-LR test
- The benchmark is an AR(2) model: Estimate the model
- We assume a SETAR(2,2). To implement the test, we need a grid-search procedure: 200 points from $[-1.0, 4.0]$
- Find the threshold value that minimizes the variance ($c^* = 2.35$)

Find the threshold



Estimation of a SETAR model

- Compute the Hansen's F-sup (=56.91)
- Compute the 95% confidence interval for the null of linearity ([4.1, 17.9])
- Conclusions?

Estimation of a SETAR model

- Estimate the SETAR mode
- Estimate the linear AR(2) and compare (R^2? AIC?)
- Conclusions?

Estimation of a STAR model

- Estimate a STAR model by having a grid-search over γ and c of size 80. ($\gamma^* = 0.2$ and $c^* = 4$)
- Compare with other 2 models (R^2? AIC?)
- Conclusions?

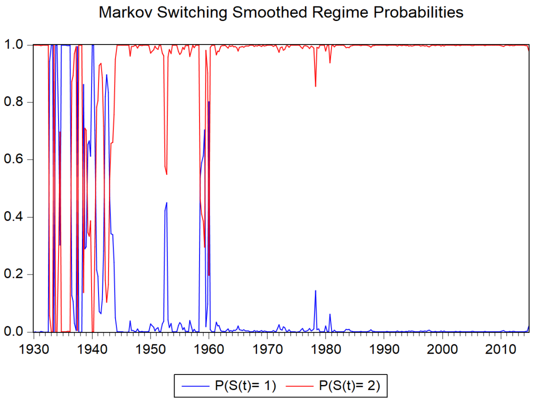
Forecasting with a SETAR and STAR models

- Compute 1-step-ahead forecasts for SETAR(2,2) and STAR(2,2) and AR(2) over the sample 2000q2-2014q4
- Compute RMSFEs and compare (AR=1.167, TAR=1.112, STAR=1.113)
- Conclusions?

Estimation of a MS model

- Estimate a MS model with one lag
- Is there any differences in the parameter depending on the regime?
- Compare with the linear AR(2)
- Look at transition probabilities
- Plot the filtered ans smoothed probabilities of being in each regime
- Forecast 1-step-ahead over the sample 2000q2-2014q4 (RMSFE=0.881)
- Conclusions?

Smoothed probabilities of being in the 2 regimes



Re-estimate the models

- A time-varying volatility in the IP series is likely to introduce some bias in the models
- Re-estimate the models since 1983q1, i.e. the start of the Great Moderation period

MS on unemployment rate

- Open the dataset *data-US-7219.xlsx* and plot the series *dunr*, the changes over 6 months of the US unemployment rate
- Estimate a MS model with 2 regimes, no AR component and swithching residual variance
- Comment estimation results (transition probas, parameters, smoothed and filtered probabilities, fitted values)
- Estimate now a 3-regime model. Comment

MS on IP manuf

- Open the dataset *data-US-7219.xlsx* and plot the series *dipim*, the growth rate over 6 months of the US manufacturing industrial production
- Estimate a MS model with 2 regimes, no AR component and swithching residual variance
- Comment estimation results (transition probas, parameters, smoothed and filtered probabilities, fitted values)
- Estimate now a 3-regime model. Comment

MS-VAR on IP manuf and Unemployment

- Estimate a MS-VAR model with 2 regimes, AR(1) component and switching residual variance
- Comment estimation results (transition probas, parameters, smoothed and filtered probabilities, fitted values)
- Estimate now a 3-regime model. Comment