A visual analysis of some macroeconomic series

Gray Calhoun
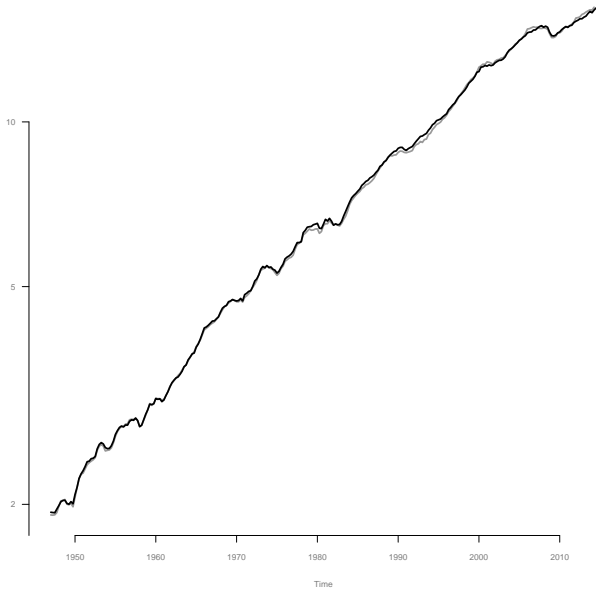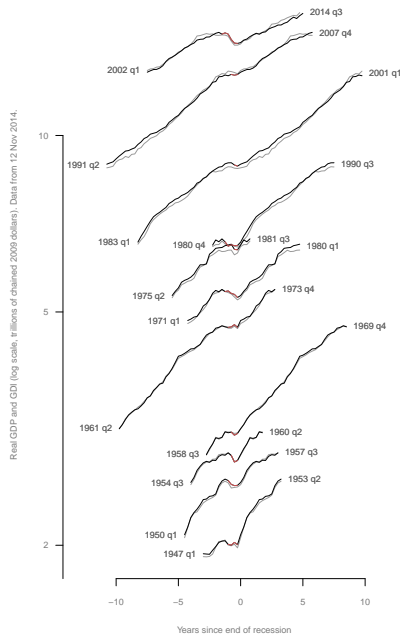
November 11th, 2014

- Look at some major US macroeconomic time-series
  - GDP
  - Inflation and price levels
  - Unemployment rate
- Also discuss some aspects of persistence
- Estimate a recession indicator based on the unemployment rate
- Focus on changes in trends and changes in recession dynamics
  - Difficult to model explicitly
  - Clearly important after visual inspection

- Slides available online: http://pseudotrue.com/dl/graphics-slides.pdf
- Lots of macroeconomic data are available through "FRED" http://research.stlouisfed.org/fred2/ including "real time data"
  - Import from FRED into R with the *quantmod* package
- In this talk, I'm going to continue a long and esteemed tradition of pretending there are no data revisions
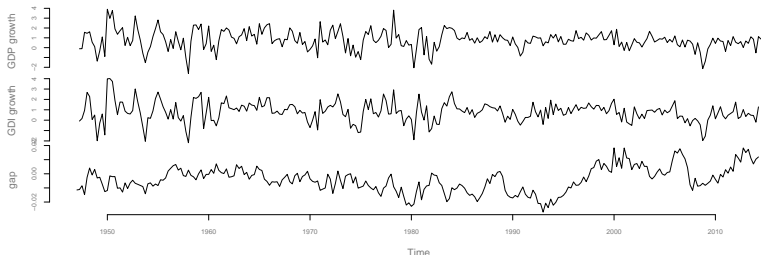
US real output, emphasis GDP

Real GDP and GDI (log scale, trillions of chained 2009 dollars). Data from 12 Nov 2014.

Time

US real output, emphasis GDP

Real GDP and GDI (log scale, trillions of chained 2009 dollars). Data from 12 Nov. 2014.

Years since end of recession

2014 q3
2007 q4
2002 q1
2001 q1
1991 q2
1990 q3
1983 q1
1980 q4
1981 q3
1980 q1
1975 q2
1973 q4
1971 q1
1969 q4
1961 q2
1960 q2
1958 q3
1957 q3
1954 q3
1953 q2
1950 q1
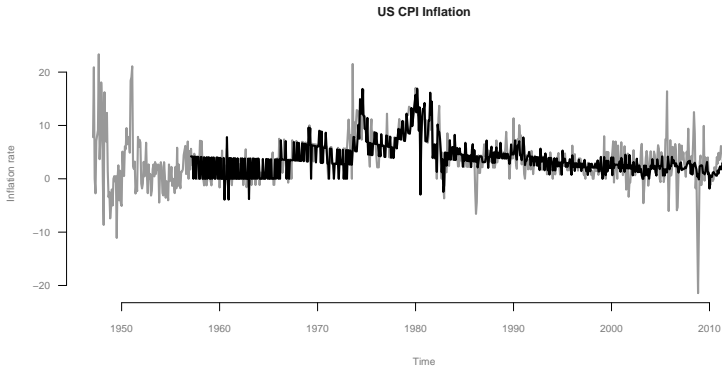1947 q1

10

5

2

−10   −5   0   5   10

Real GDP and GDI growth rates and discrepency

- The original series are (almost certainly) *cointegrated*, so modeling the first difference is inappropriate

- If we want to look at dynamics, we should estimate an Error Correction Model

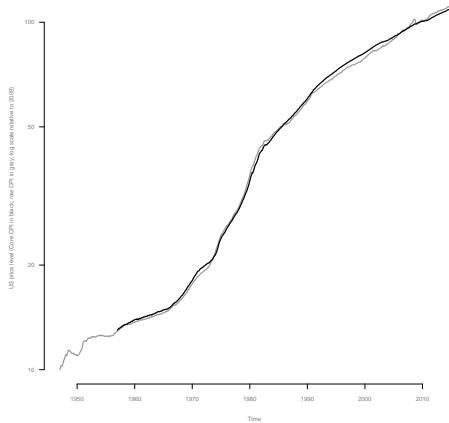$$\Delta y_t = a_0 + b(y_{2,t-1} - y_{1,t-1}) + \sum_{i=1}^{4} A_i \Delta y_{t-i} + \varepsilon_t$$

- $\Delta y_t = (\Delta GDP_t, \Delta GDI_t)'$
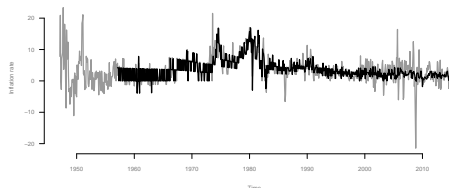
US CPI Inflation

Interesting aspect of inflation

- The Federal Reserve has a **strong** influence on inflation through policy
    - Intentional disinflation in 1979 through early 80s
- Currently targets inflation rate (makes inflation I(0), price levels (1))
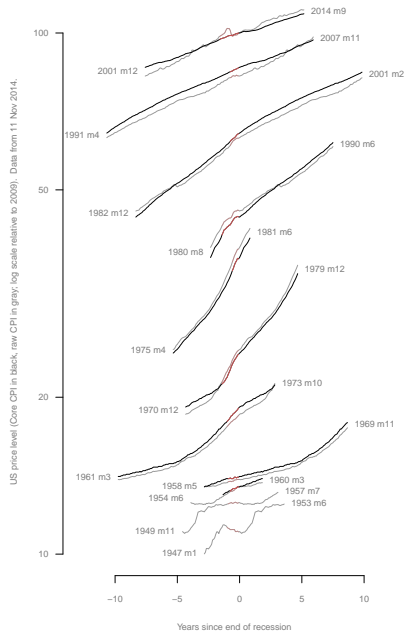- Talk of targeting price level or nominal GDP, both would make price level mean-reverting (around trend)
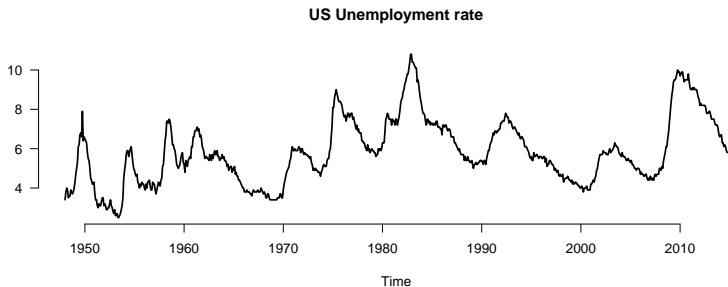
log US CPI

US price level (Core CPI in black, raw CPI in grey; log scale relative to 2008)

Time

US CPI Inflation

Inflation rate

Time

US CPI, piecewise and centered at recession troughs

US price level (Core CPI in black, raw CPI in gray, log scale relative to 2009). Data from 11 Nov 2014.

Years since end of recession

2014 m9
2007 m11
2001 m12
2001 m2
1991 m4
1990 m6
1982 m12
1981 m6
1980 m8
1979 m12
1975 m4
1973 m10
1970 m12
1969 m11
1961 m3
1960 m3
1958 m5
1957 m7
1954 m6
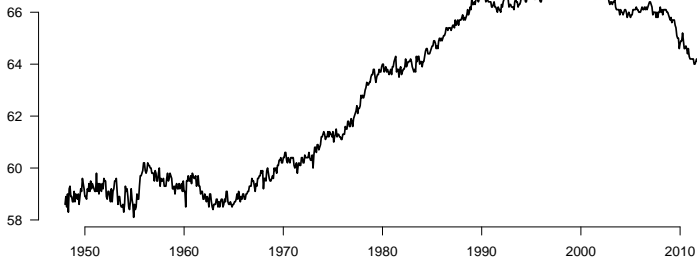1953 m6
1949 m11
1947 m1

US Unemployment rate

Remember, the unemployment rate is the percentage of people who are in the labor force but are not working

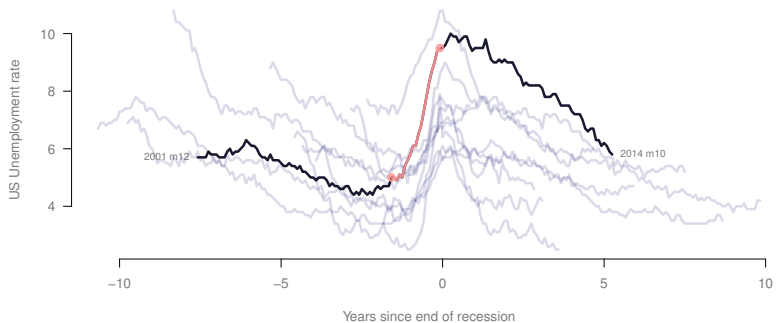- If people leave the labor force because they can't find a job, the unemployment rate goes down!
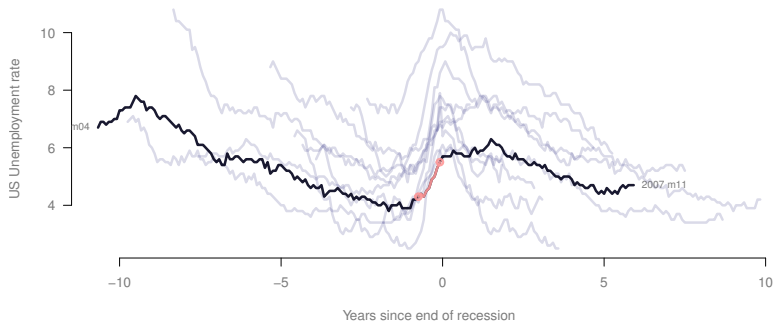
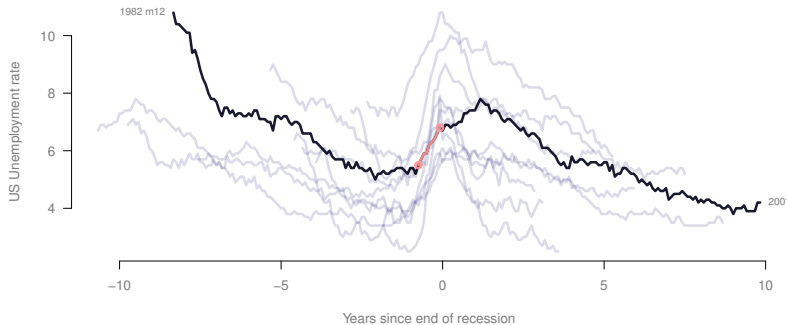**US Unemployment rate**
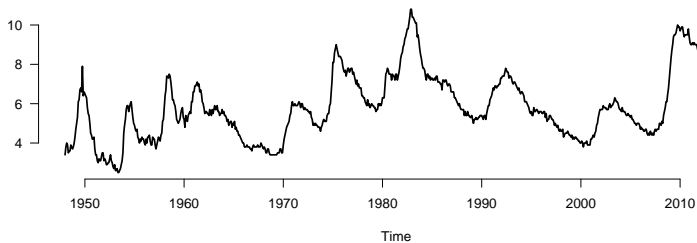
Labor force participation rate

US unemployment rate, 2001 m12...2014 m10 (updated Wed Nov 12, 2014 at 00:02)
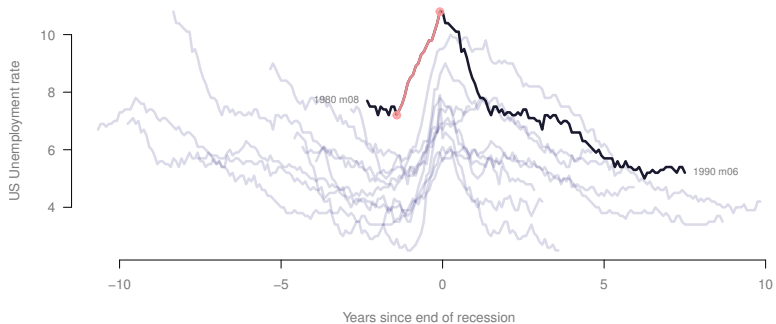
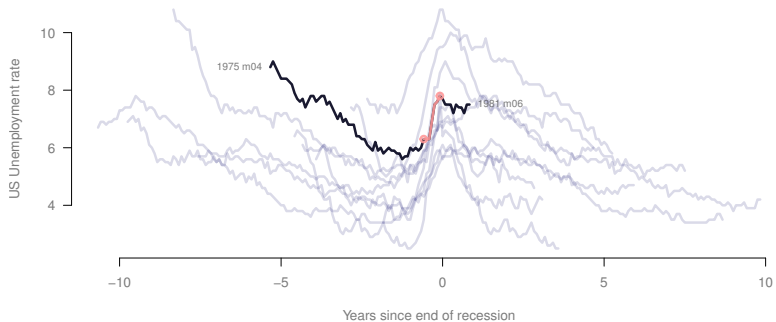US unemployment rate, 1991 m04...2007 m11 (updated Wed Nov 12, 2014 at 00:02)

US unemployment rate, 1982 m12...2001 m02 (updated Wed Nov 12, 2014 at 00:02)

US unemployment rate, 1980 m08...1990 m06 (updated Wed Nov 12, 2014 at 00:02)

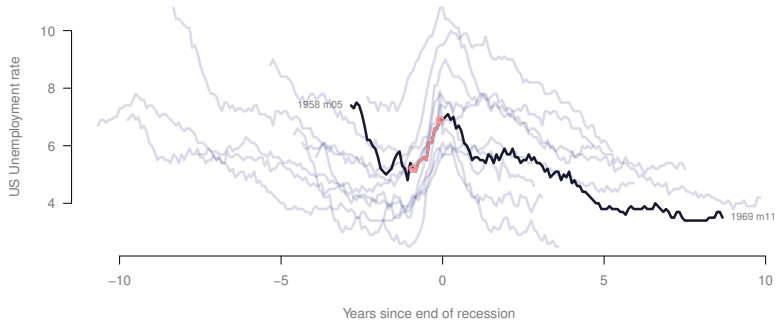US unemployment rate, 1975 m04...1981 m06 (updated Wed Nov 12, 2014 at 00:02)

US unemployment rate, 1970 m12...1979 m12 (updated Wed Nov 12, 2014 at 00:02)
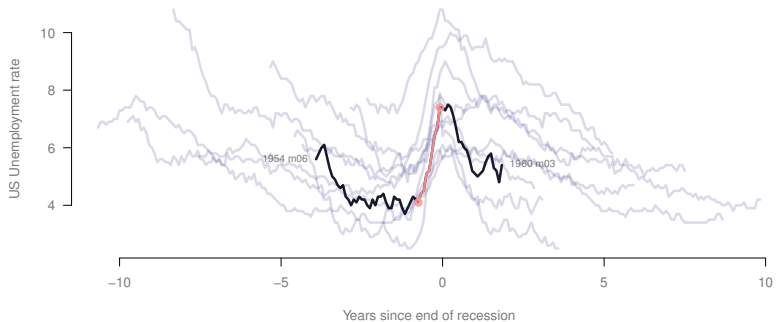
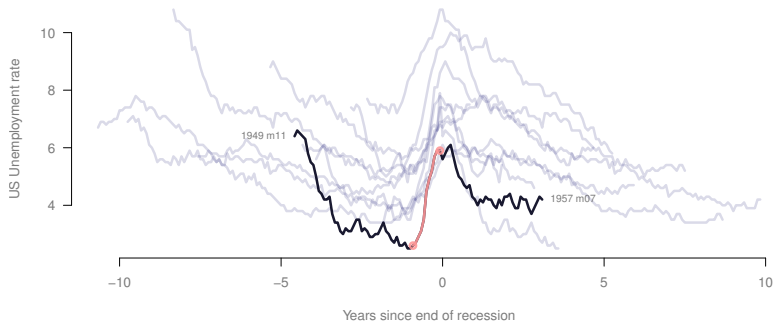US unemployment rate, 1961 m03...1973 m10 (updated Wed Nov 12, 2014 at 00:02)

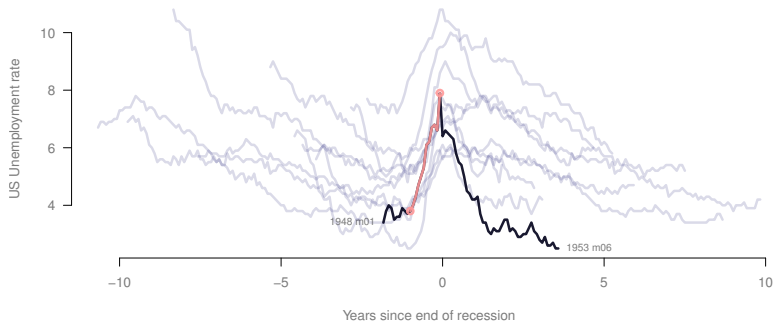US unemployment rate, 1958 m05...1969 m11 (updated Wed Nov 12, 2014 at 00:02)

US unemployment rate, 1954 m06...1960 m03 (updated Wed Nov 12, 2014 at 00:02)

US unemployment rate, 1949 m11...1957 m07 (updated Wed Nov 12, 2014 at 00:02)

US unemployment rate, 1948 m01...1953 m06 (updated Wed Nov 12, 2014 at 00:02)

- The most recent recesssion was huge
    - Unemployment rose a lot
    - GDP fell a lot
- The recovery from the last recession has been very steady
    - Initial recovery period more gradual than we saw in early 80s recessions and before
    - Also substantially longer (partly because of the size of the recession)
- The recovery/expansion is fairly long relative to past expansions

- Probably not, but we may want to quantify it
- Jim Hamilton has a recession indicator using a simple state-space model (http://econbrowser.com/recession-index)
    - NBER recession dating is slow http://www.nber.org/cycles.html
- I want one too
    - Jim's too responsible to make fun predictions
    - I'd like to see whether we learn much from new data releases
- The model

$$S_t = \begin{cases} 1 & \text{if period } t \text{ is a recession} \\ 2 & \text{if period } t \text{ is not a recession} \end{cases}$$

$$\Pr[S_{t+1} = 1 \mid S_t] = \begin{cases} p & \text{if period } t \text{ is a recession} \\ q & \text{if period } t \text{ is not a recession} \end{cases}$$

$$\text{logit}^{-1}(\Delta unemployment_t) \mid S_t \sim N(\mu_{S_t}, \sigma^2)$$

- These models are fairly easy to estimate with MCMC/Gibbs
- Uninformative beta prior on p and q
- Uninformative Normal-inverse gamma prior on μ_1, μ_2, σ^2
- Want to know

$$\Pr[S_{T+1} = 1 \mid unemployment_1, \ldots, unemployment_T] \tag{1}$$

and

$$\Pr[S_{T+1} = 1 \mid unemployment_1, \ldots, unemployment_{T-1}] \tag{2}$$

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$$\Pr[S_{T+1} = 1 \mid unemployment_1, \ldots, unemployment_{T-1}] \tag{2}$$

- (1): 2% probability we are in a recession in November (based on 1200 simulations)
- (2): 3.25% assigned probability before learning October's unemployment rate

- This model makes terrible forecsts
- It has missed historical recessions
- It occasionally predicts 6 year recessions

Sample unemployment rate forecasts from this model (blue)
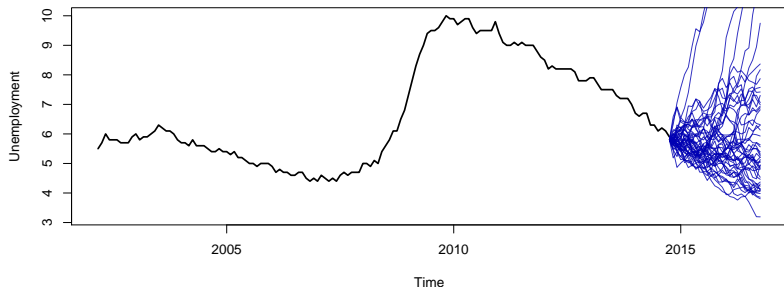
Thanks!

- Thanks for coming!
- Comments are welcome
- Also over email: gcalhoun@iastate.edu