# ECON 815

# Introduction

Winter 2015

# What is the course about?

Modern macroeconomics is about understanding cyclical fluctuations.

Important for:

- forecasting
- analyze policy changes
- design optimal policy responses to shocks

Main issue:

The first task merely requires an econometric (reduced form) toolkit.

The second requires a theoretical (structural) model.

The third requires a combination of the two.

# A Brief History of Thought

Classic nonstructural approach:

- reduced form, univariate ARMA models (Box-Jenkins)

Keynesian large-scale structural models:

- ad-hoc postulated, simultaneous equation models
- not micro-founded, nor connected to long-run
- equation-by-equation estimation

Modern nonstructural models:

- multivariate time series analysis
- error correction models & VARs
- common factor models

**DSGE models**:

- micro-founded and trend-dependent
- structurally estimated and/or calibrated

# What is DSGE about?

**D**ynamic – how an economy evolves throughout time

**S**tochastic – in response to shocks

**G**eneral – at a high level of aggregation

**E**quilibrium – based on (optimal) decision rules.

Key Aspects:

- The core is a structural, microfounded model.
- Due to non-linearities, the model is solved in an approximate way.
- The model is then compared to the data taking the model serious.
- It is thus a synthesis of reduced form and structural approaches.

# Overview

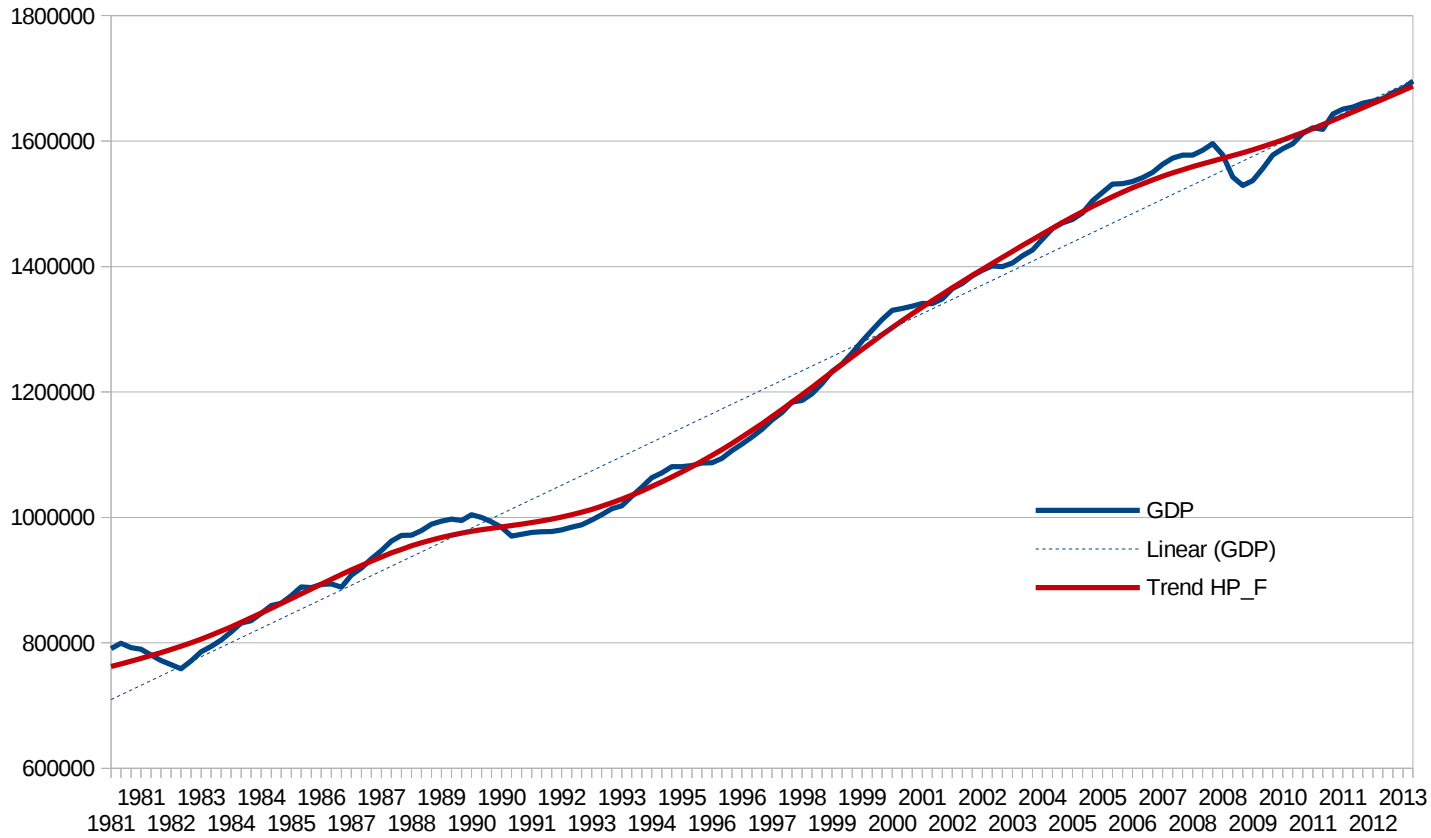
1) Two-period economy

2) Long-run growth

3) The canonical RBC model
   - steady state
   - linear approximations
   - calibration
   - computing IRFs and simulate
   - (S)VARs

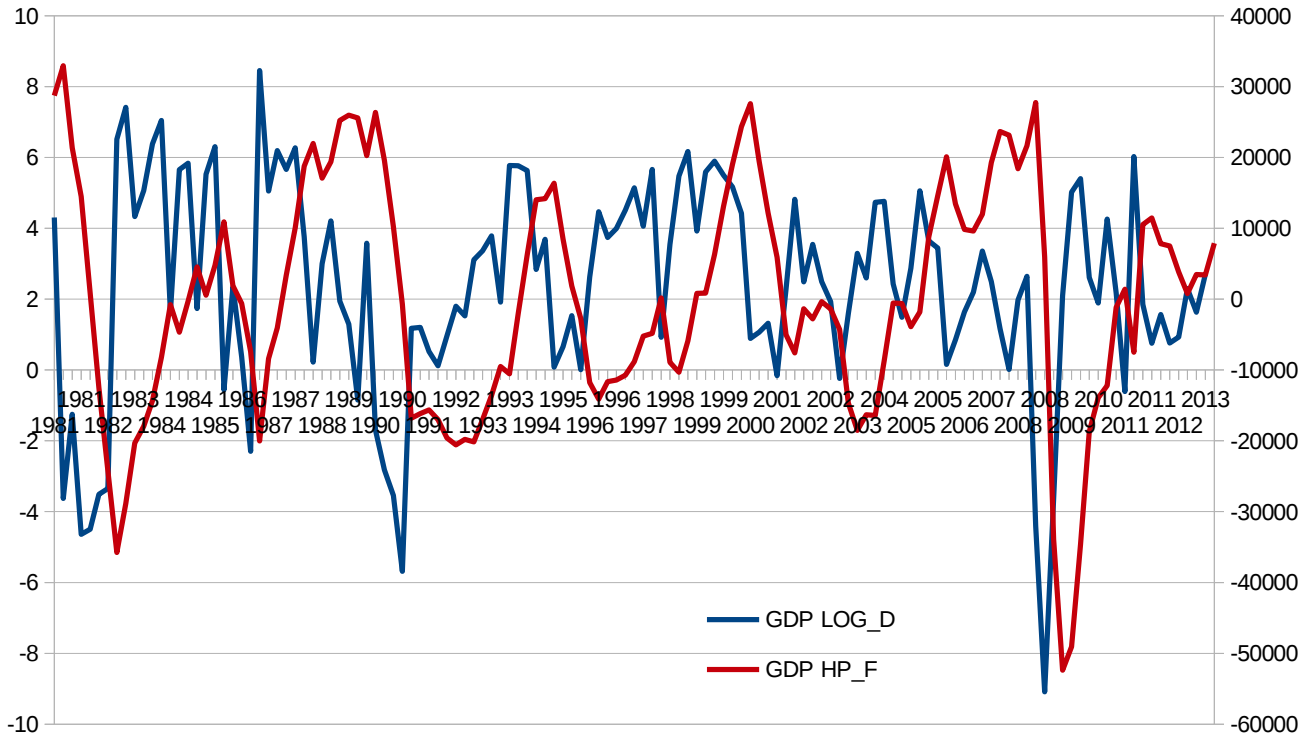
4) DSGE models and Monetary Policy
   - evidence
   - Lucas-island economy and Newkeynesian model
   - interest rate rules
   - optimal policy

# A Glance at the Data




Canadian Real GDP – 1981:1 - 2013:3

Issue: GDP is I(1) and we want to explain fluctuations around trend.




Fluctuations in Real GDP – 1981:1 - 2013:3

Issue: There are many ways to "detrend" the data.

# Stationarity and Detrending

**1)** First-differences

- growth rates are given by $\frac{\dot{y}_t}{y_t} = \frac{d \ln y_t}{dt}$
- or: $\frac{y_t - y_{t-1}}{y_{t-1}}$ which can be approximated by $\Delta \ln y_t$

**2)** HP filter

- decompose series into a cyclical component and a trend

$$y_t = y_t^g + y_t^c + \epsilon_t$$

- least square estimator

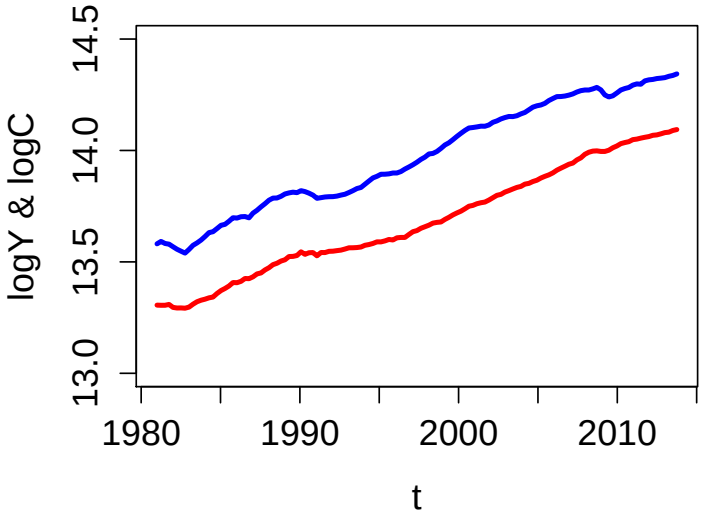
$$\min_{y_t^g} \sum_{t=0}^{T} (y_t - y_t^g)^2 + \lambda \sum_{t=0}^{T} \left( \Delta^2 y_t^g \right)^2$$

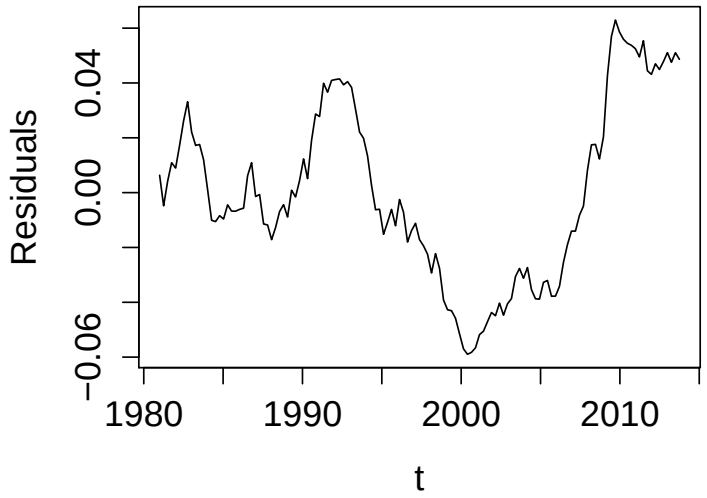
- for quarterly business cycle data set $\lambda = 1600$

## 3) Cointegration

- Take two time series, $y_t$ and $x_t$.
- They are cointegrated whenever there exists some $\gamma$ s.th. $\epsilon_t = y_t - \gamma x_t$ is I(0).
- If the variables are cointegrated, they have a common trend.
- Then simply differencing variable by variable would lose information.
- We want to purge the common trend from the variables to study short-term deviations from that trend.

# Classic example: Consumption and Output




Canadian Real GDP (blue) and Consumption (red) – 1981:1 - 2013:3

Residuals from Cointegration

Empirical results will be different if one simply detrends output and consumption separately, rather than taking into account the long-run relationship.

# Second Moments

"Classic" Approach of DSGE:

- calibrate the data
- solve the model
- simulate the model
- compare moments (or IRFs to shocks)

Mean Annual Growth, Standard Deviation and Covariance with Output
(Canada 1981:1 – 2013:3)

| | Mean | $\frac{SD}{SD_Y}$ | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Output | 2.35 | 1 | 0.03 | 0.21 | 0.31 | 0.55 | 1 | 0.55 | 0.31 | 0.21 | 0.03 |
| Cons. | 2.43 | 0.72 | -0.13 | 0.21 | 0.24 | 0.32 | 0.53 | 0.31 | 0.26 | 0.15 | 0.07 |
| Inv. | 2.92 | 5.12 | -0.01 | 0.09 | 0.32 | 0.47 | 0.59 | 0.48 | 0.15 | 0.00 | -0.07 |
| Hours | 1.22 | 0.97 | -0.08 | 0.07 | 0.25 | 0.53 | 0.70 | 0.61 | 0.35 | 0.18 | 0.09 |
| Prod. | 1.13 | 0.76 | 0.15 | 0.19 | 0.10 | 0.05 | 0.41 | -0.05 | -0.04 | 0.05 | -0.08 |

# Stylized RBC Facts

- stable long-run trend growth (balanced growth path)
- investment fluctuates more than output
- consumption is smooth relative to output
- hours and output fluctuate about the same (but avg. weekly hours fluctuate much less)
- productivity is procyclical, but fluctuates somewhat less than output
- real wages vary less than productivity and avg. compensation not correlated with output

**Conclusion:**

**Technology shocks should play a large role with investment and labor input being the main propagating mechansims.**