ECON 310 - MACROECONOMIC THEORY

Instructor: Dr. Juergen Jung

Towson University

Disclaimer

These lecture notes are customized for Intermediate Macroeconomics 310 course at Towson University. They are not guaranteed to be error-free. Comments and corrections are greatly appreciated. They are derived from the Powerpoint©slides from online resources provided by Pearson Addison-Wesley. The URL is: http://www.aw-bc.com/williamson

These lecture notes are meant as complement to the textbook and not a substitute. They are created for pedagogical purposes to provide a link to the textbook. These notes can be distributed with prior permission.
This version compiled September 7, 2016.

Chapter 3: Business Cycle Measurement

1. Understand the business cycle facts and concepts of co-movements
2. Regularities in GDP fluctuations
3. Co-movement
4. Behavior of Key Macroeconomic Variables

Business Cycle Measurement

- A trend is a trend is a trend,
  But the question is, will it bend,
  Will it alter its course,
  Through some unforeseen force,
  And come to a premature end?

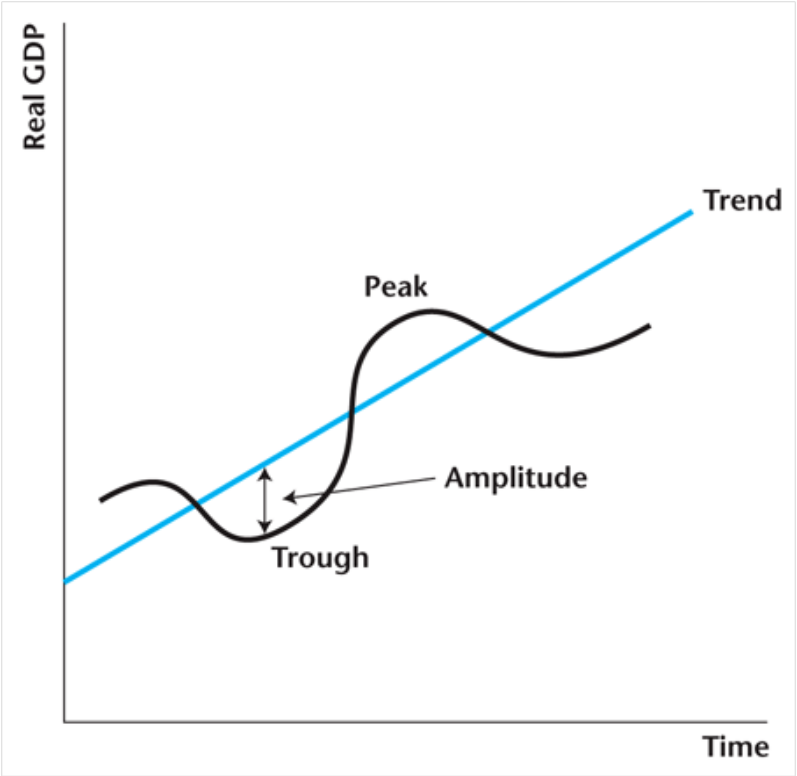
-Sir Alec Cairncross, Essays in Economic Management, 1971

- Data tells us what happens in reality
- Theory/Models help us explain the data
- Macroeconomics is interplay between the two

GDP: Growth versus Cycles

- Gross Domestic Product (GDP) - measure of aggregate activity of an economy.
- Time-series data (Data compiled by statistical agency)
- What is a trend/cycles?
- Growth = Trend
- Fluctuations about trend in real GDP
- Cycles = Deviations from trend
- Peaks are booms while Troughs are recessions

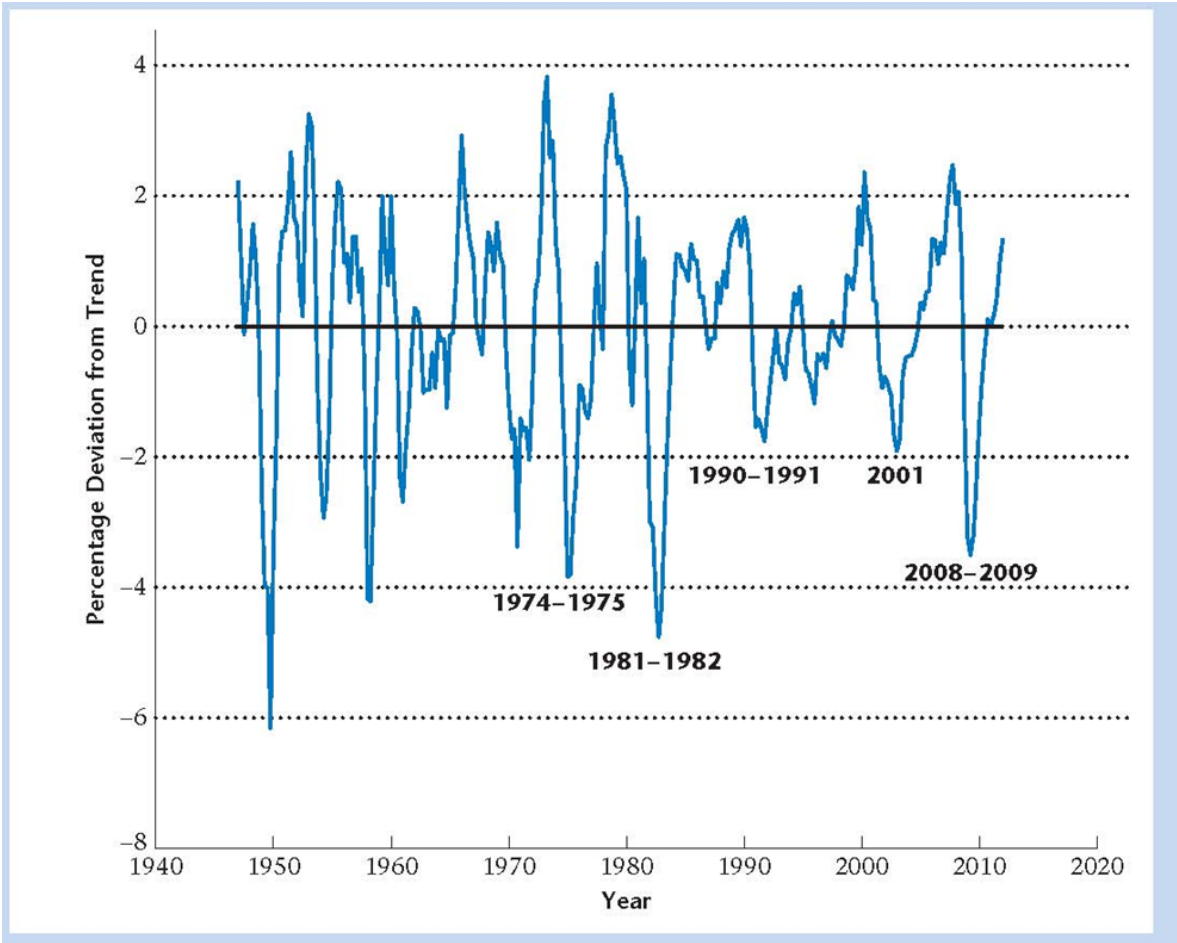
Figure 1: Idealized Business Cycles



Persistence

- Deviations from trend in real GDP is persistent
- That is, if it is up, it stays up for a few periods; vice-versa
- Three features of deviations from trend:
  1. Choppy
  2. Amplitude (size) of deviations from trend is not regular
  3. No regularity in frequency
- Forecasting?
- WSJ Semiannual Economic Forecasting Survey (about 50 participants)

Figure 2: Percentage deviations from Trend



Co-movement and Correlations

- Macro variables fluctuate together in strong regular patterns
- Correlation is a measure of this relationship
- Analytical formula:

$$\begin{aligned}\rho_{xy} &= \frac{Cov(x,y)}{\sqrt{Var(X)Var(Y)}} \\ &= \frac{E[x-E(x)]E[y-E(y)]}{\sqrt{E[x-E(x)]^2 E[y-E(y)]^2}}\end{aligned}$$

Sample

$$r_{xy} = \frac{\sum[x-\bar{x}][y-\bar{y}]}{\sqrt{\sum[x-\bar{x}]^2 \sum[y-\bar{y}]^2}}$$

- By definition correlaton coefficient $-1 \leq \rho_{xy} \leq 1$
- Perfect positive correlation $= 1$
- Perfect negative correlation $=$ -1
- No correlation/uncorrelated $= 0$
- Positive correlation aka procyclical
- Negative correlation aka countercyclical
- No correlation aka acyclical
- Time series plots
- Scatterplots

Figure 3: Time-series plots of x and y

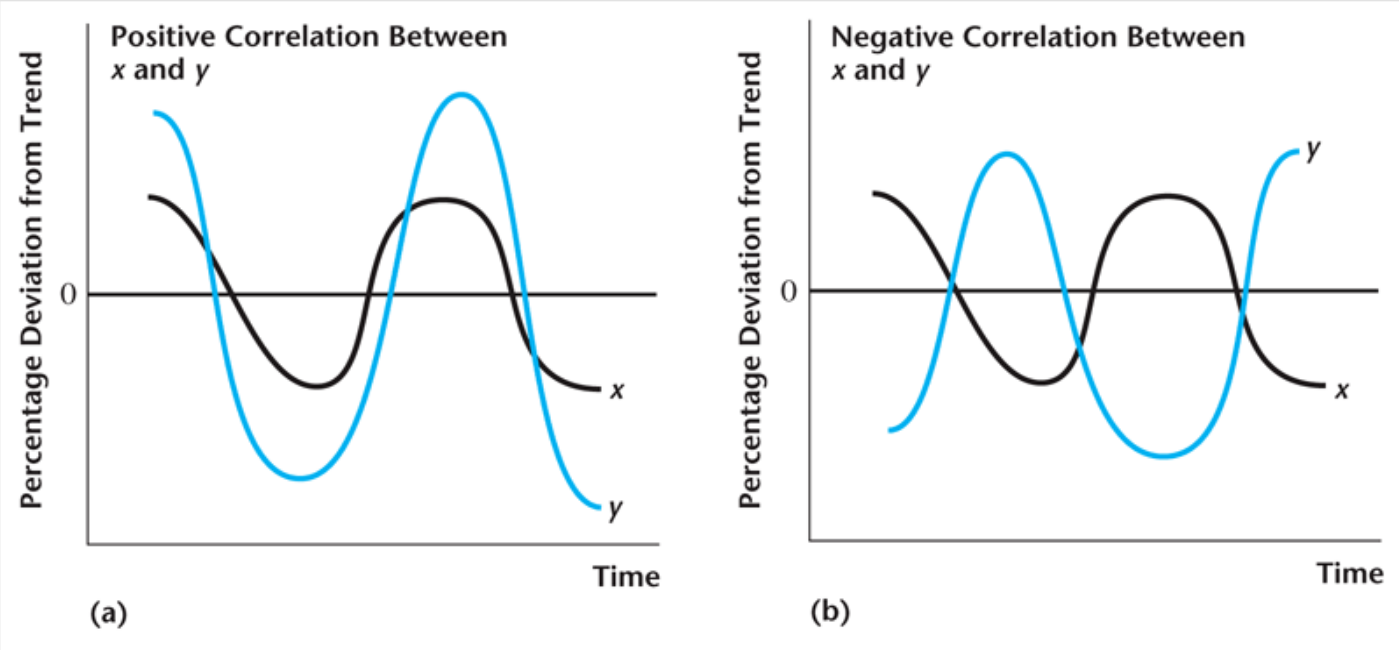
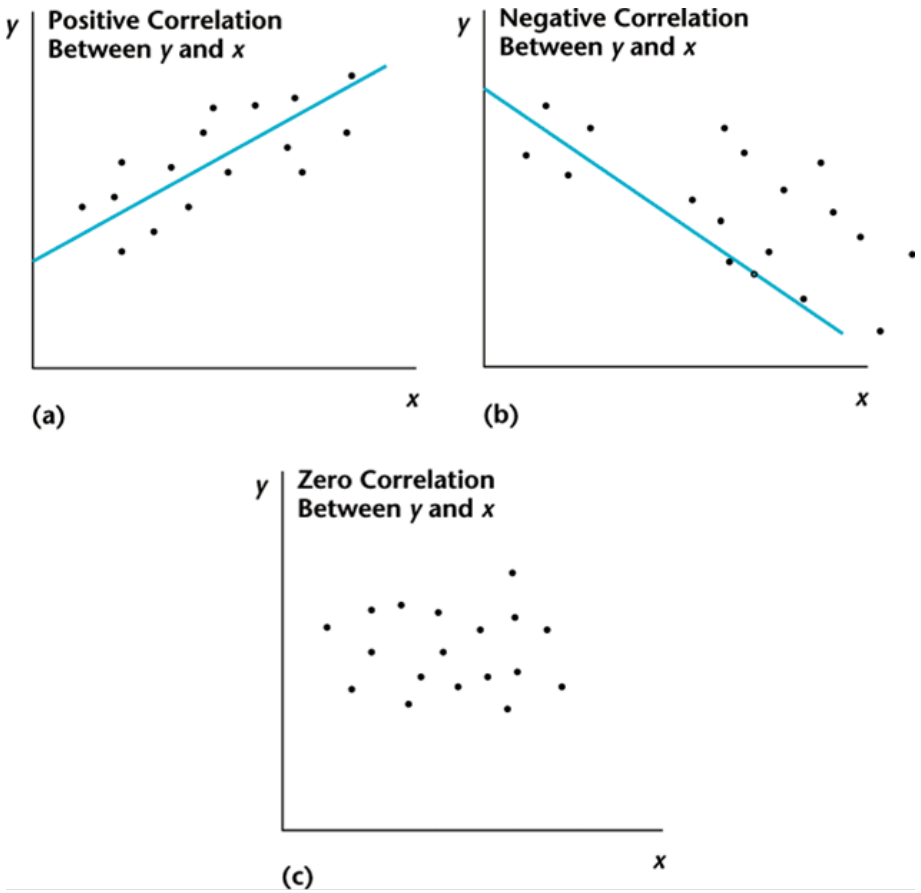


Figure 4: Scatter plots of x and y



Correlation with Real GDP

- If the deviations from trend in a macroeconomic variable are positively (negatively) correlated with the deviations from trend in real GDP, then that variable is pro-cyclical (counter-cyclical)
- If a macroeconomic variable is neither pro-cyclical nor counter-cyclical, it is a-cyclical

Figure 5: Time-series plots of Imports and GDP

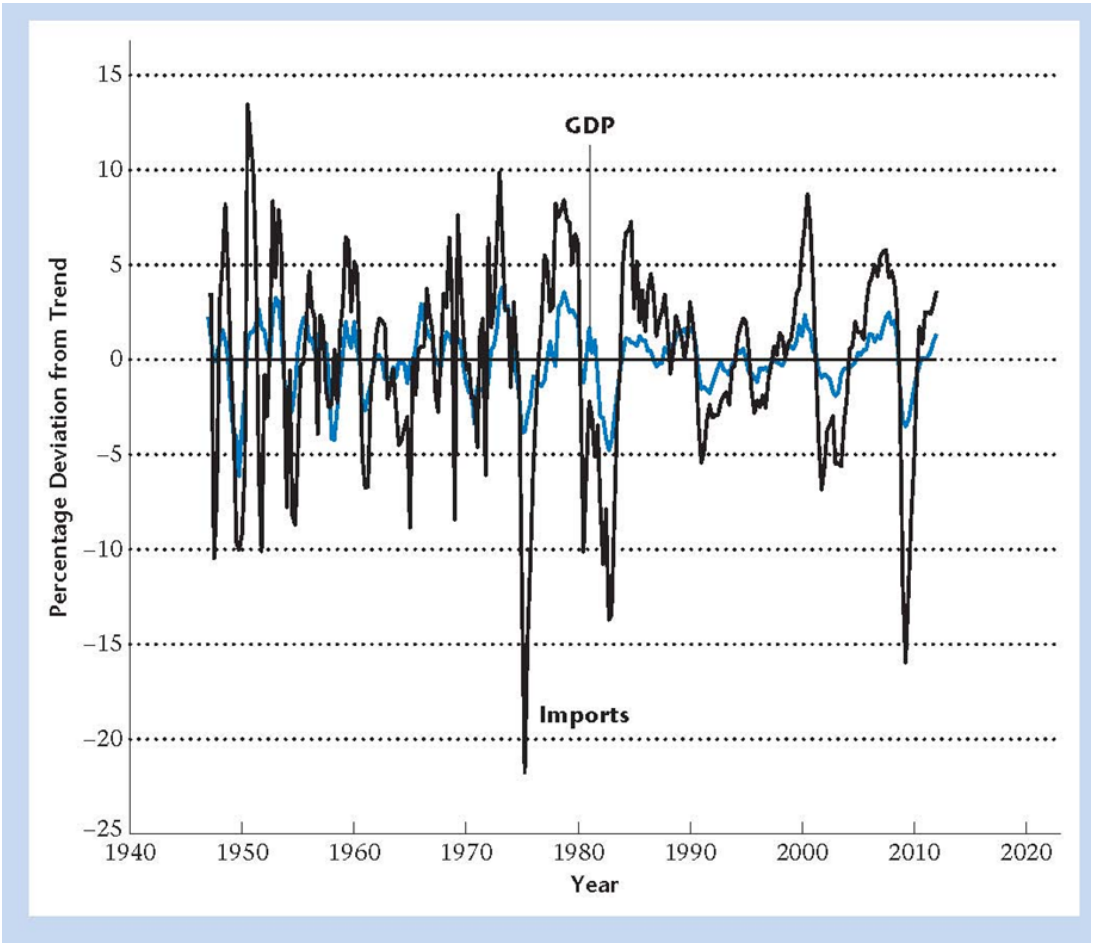
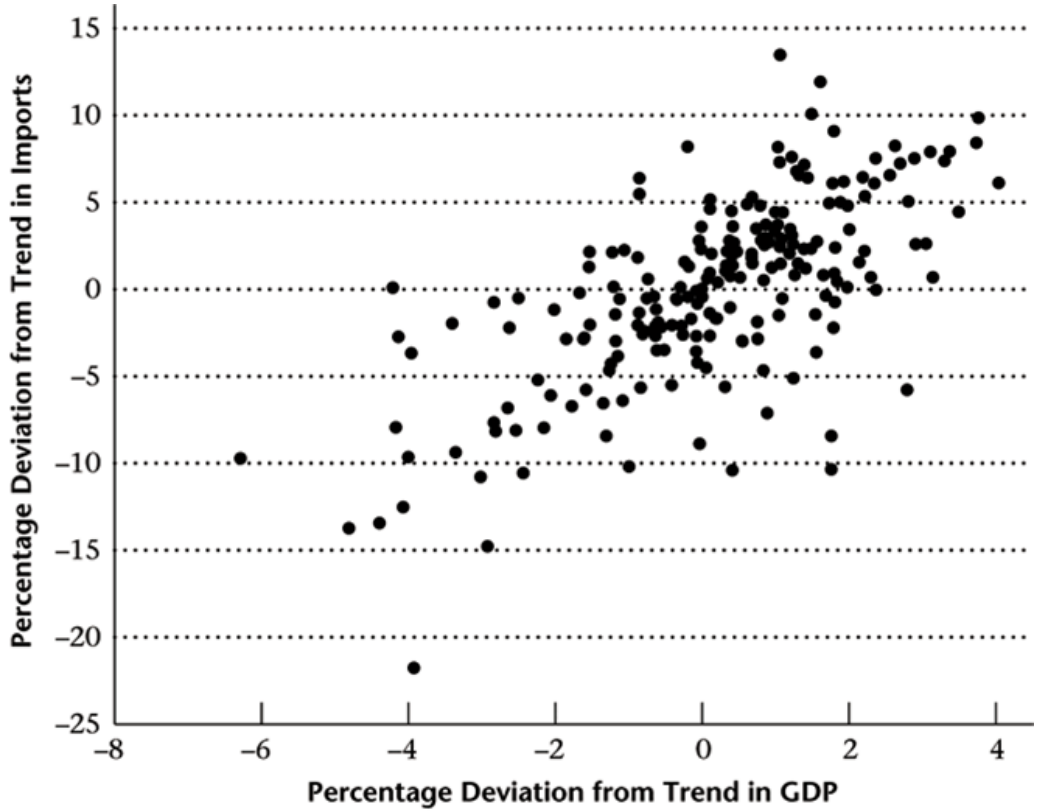


Figure 6: Scatter plots of Imports and GDP



Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Other statistical definitions

- Correlations over time
- Lags and Leads
- Leading variable: if x is useful in predicting future path GDP
- Lagging variable: if GDP is useful in predicting future path x
- Coincident variable: neither lead or lag
- Useful in forecasting? Conference Board:
  Index of leading economics indicators (Figure 3.8)
- Cyclical variability: standard deviation (square root of variance)

Figure 7: Leading and Lagging Variables

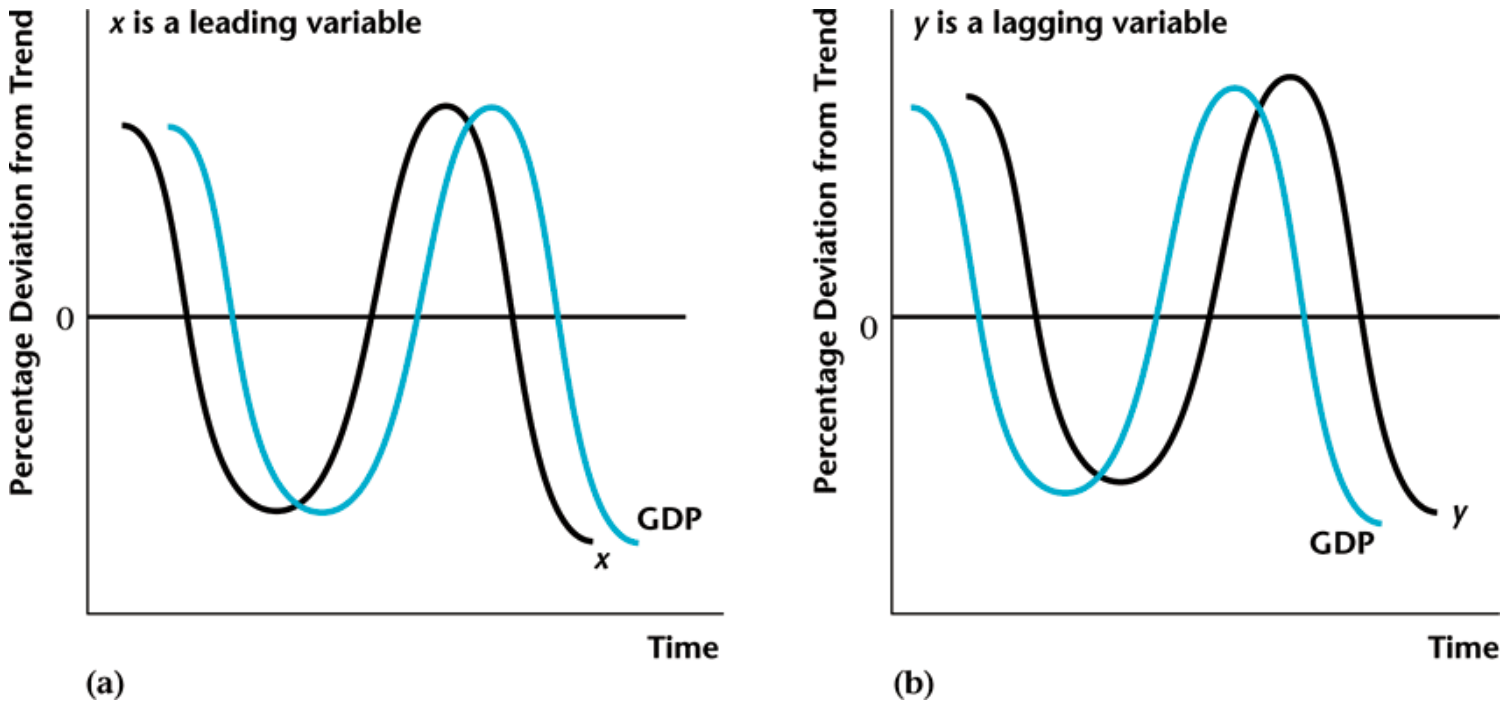
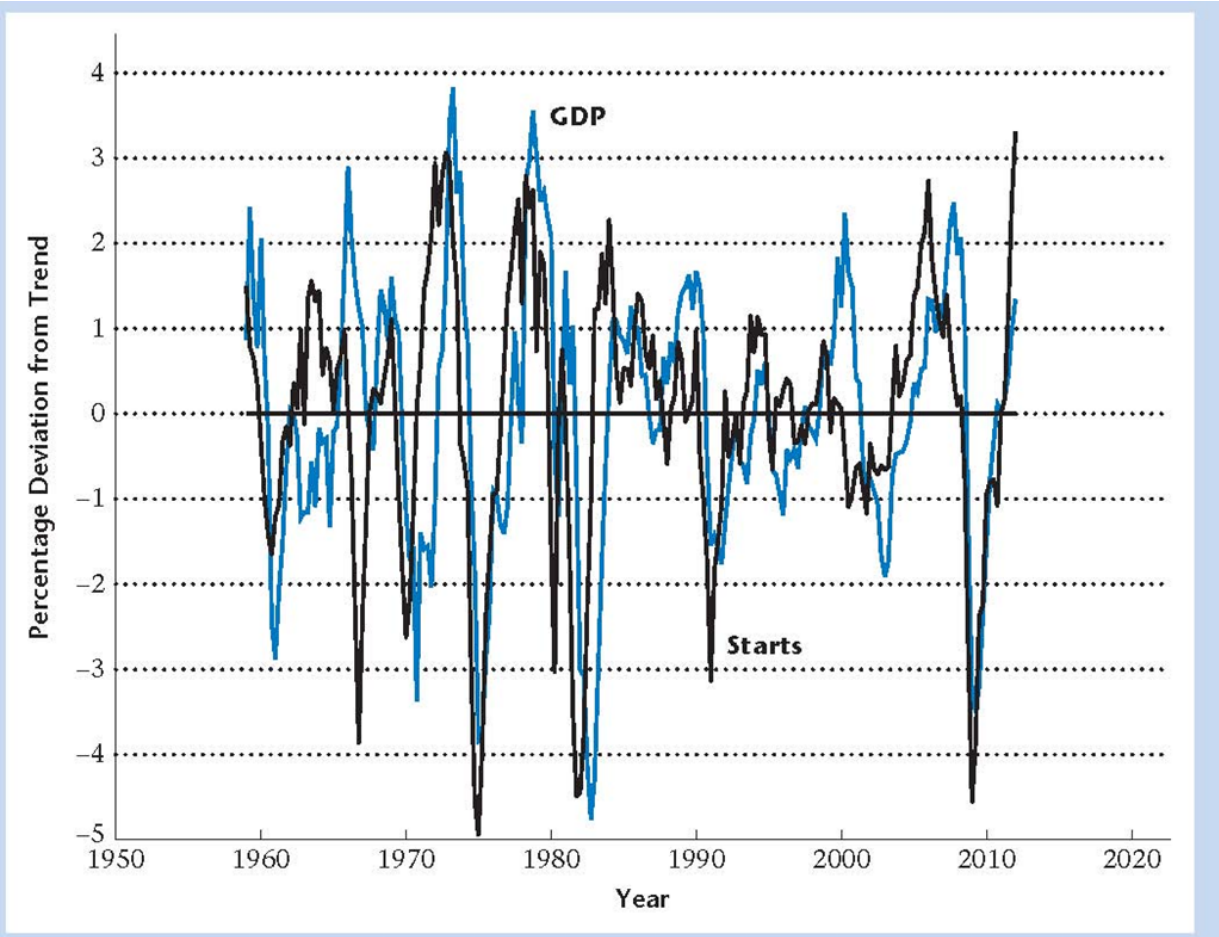


Figure 8: Leading Index and deviations from GDP Trend



Behavior of Key Macroeconomic Variables

- Components of GDP: consumption and investment.
- Nominal variables: price level and money supply.
- Labor market variables: employment, real wage, average labor productivity.

Behavior of Key Macroeconomic Variables (cont.)

Figure 9: Deviations from GDP Trend and Consumption

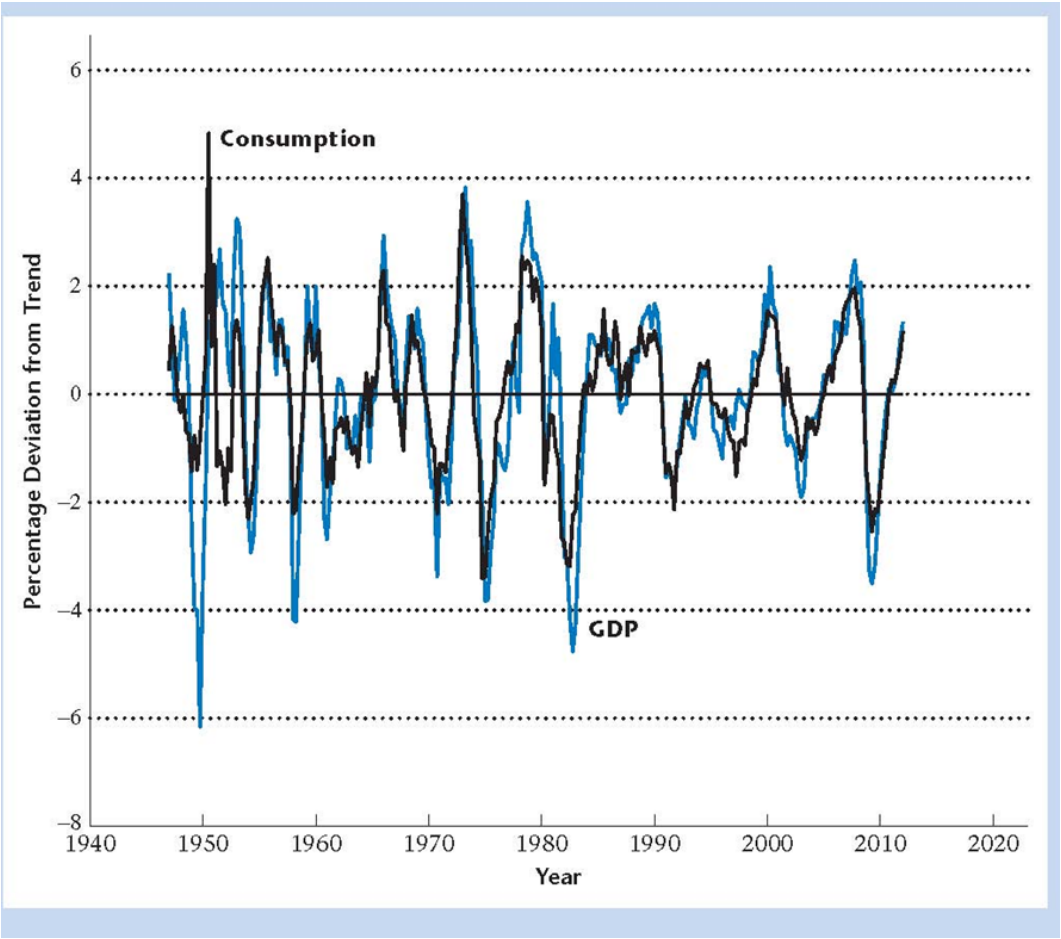
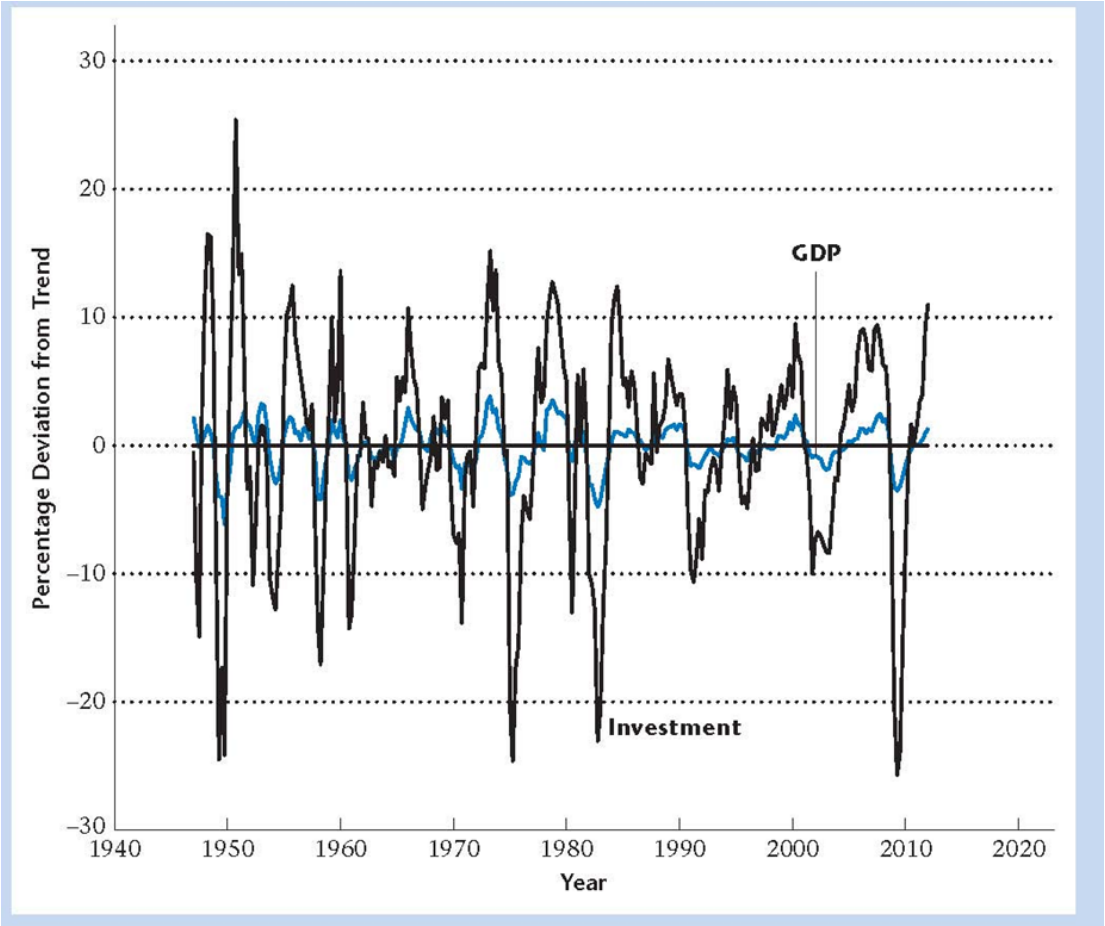


Figure 10: Deviations from GDP Trend and Investment



Nominal Variables

- Phillips curve
- Negative relationship between inflation and unemployment
- Short-run tradeoff (Unstable relationship)
- post hoc ergo propter hoc
- Correlation does not imply causation!
- Friedman and Schwartz: A Monetary History of the US 1867-1960
- Constructed consistent measures of money supply and financial variables
- Nominal variables (money supply) with real variables (aggregate activity)
- Money supply plays important role in business cycles
- Money is a leading and procyclical variable
- Does money cause output?
- Identification?

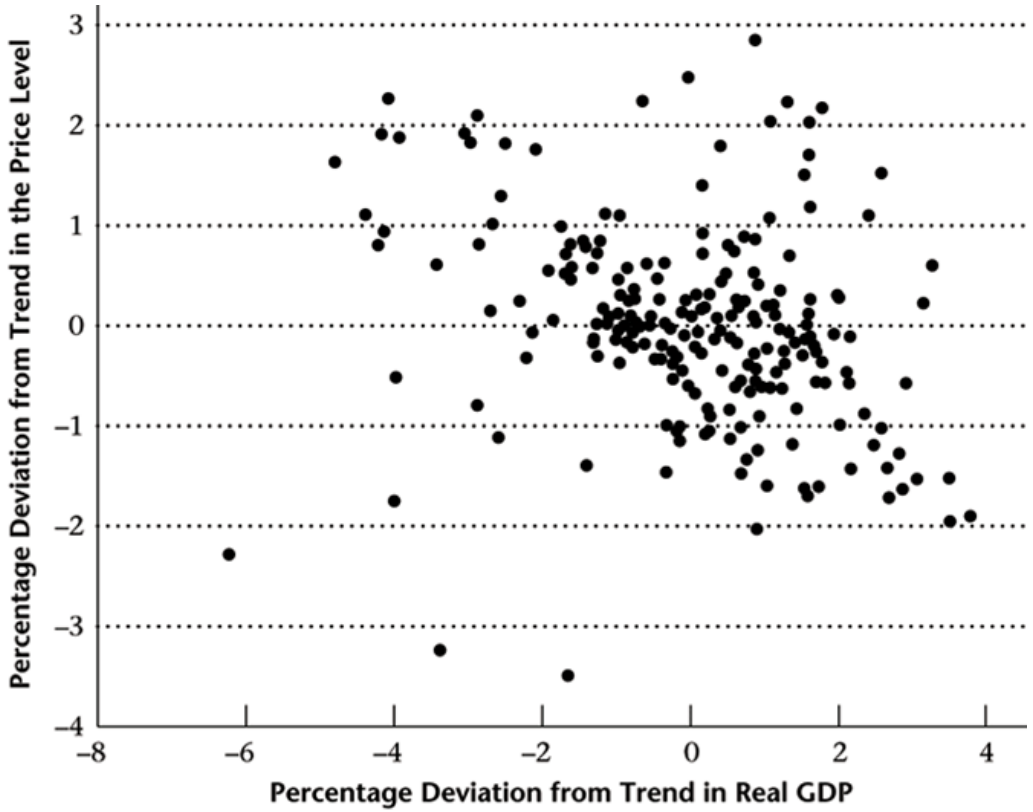
Nominal Variables (cont.)

1. changes in output
2. monetary policy
3. third (outside) variable

Milton Friedman (1912-2006) and Anna Schwartz

Friedman and Schwartz: A Monetary History of the US 1867-1960

Figure 11: Deviations from GDP Trend and Price Level



Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Figure 12: Deviations GDP Trend and Price Level

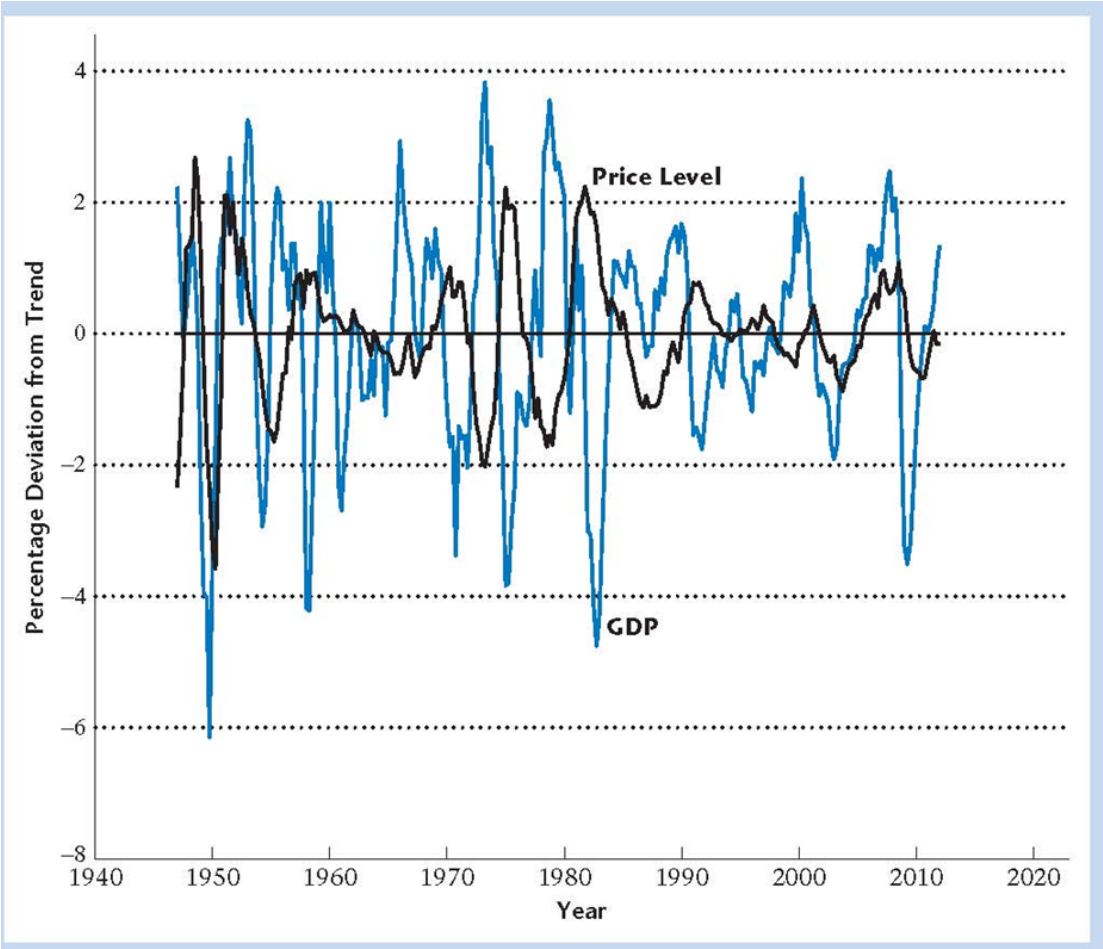
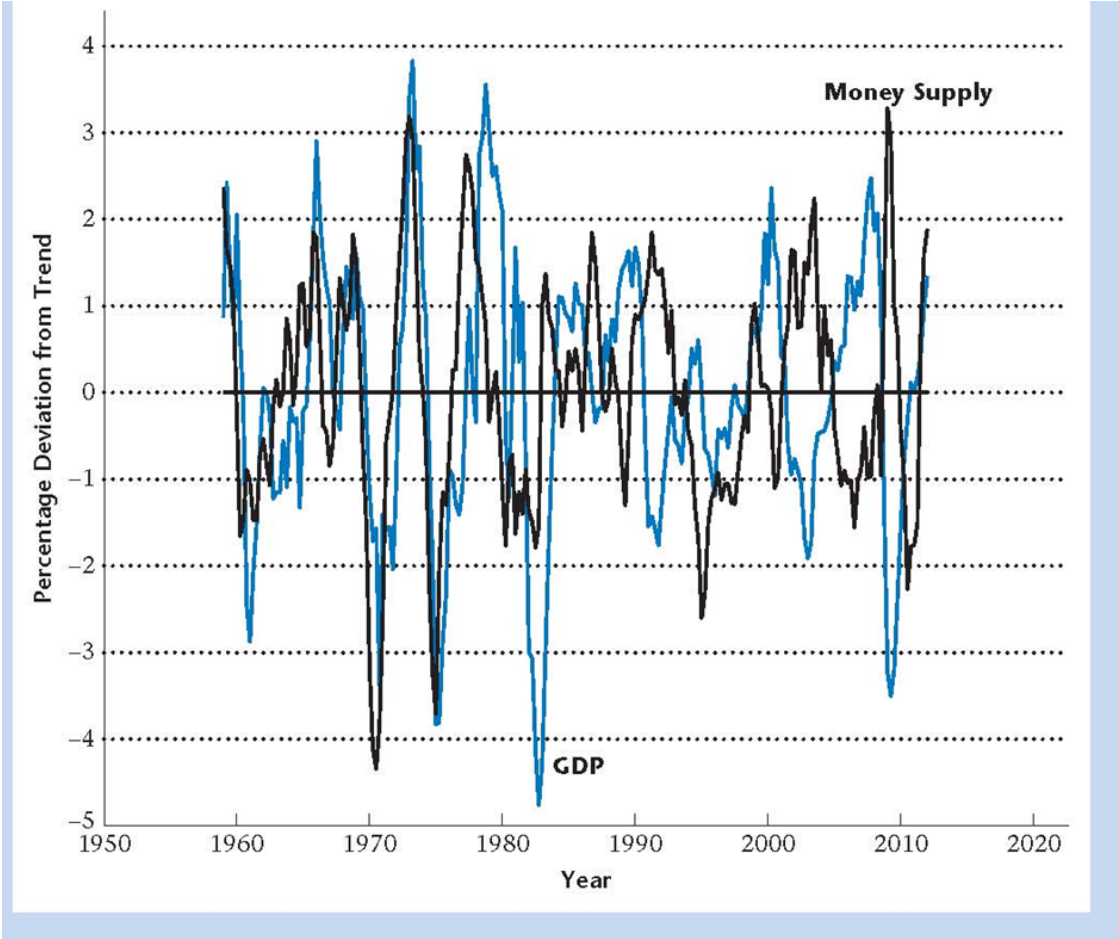


Figure 13: Deviations GDP Trend and Money Supply



Labor Market Variables

- Real wage = average of all wages divided by price level (procyclical?)
- Difficult to measure the real wage
- Composition of labor force changes with business cycles
- Productivity - different measures
  Average labor productivity= aggregate output/ total labor input = Y/N
  1. Procyclical
  2. Correlation is 0.83
  3. Less volatile

$$\frac{\sigma_{prod}}{\sigma_Y} = 62.8\%$$

  4. Coincidental variable

Figure 14: Deviations GDP Trend and Employment

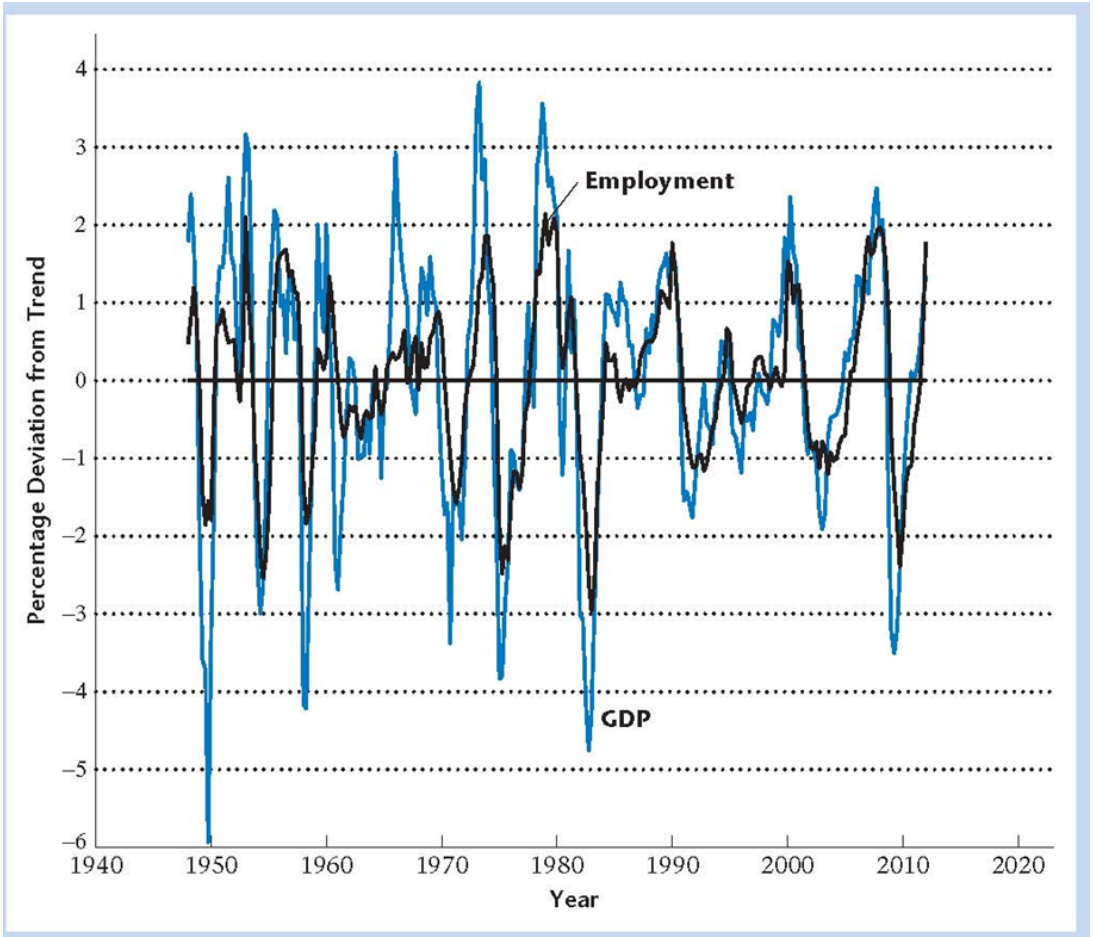


Figure 15: Jobless Recovery

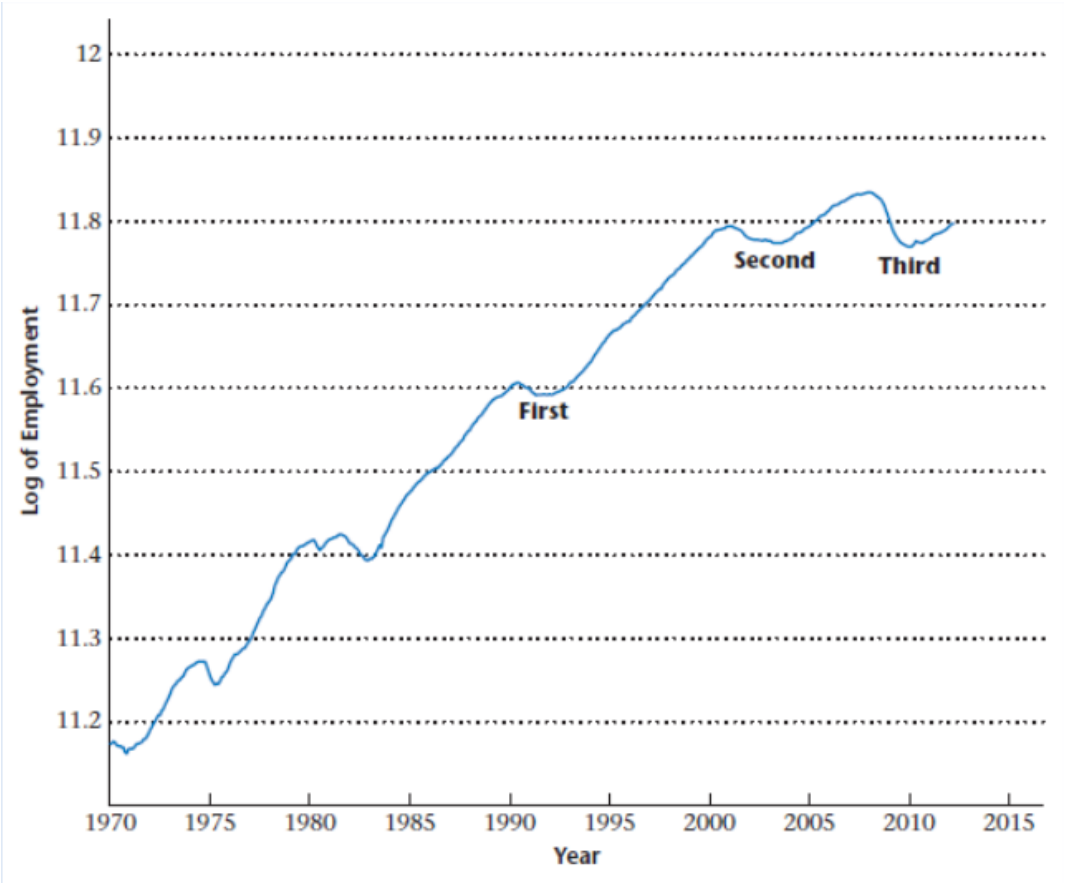


Figure 16: Deviations GDP Trend and E[Productivity]

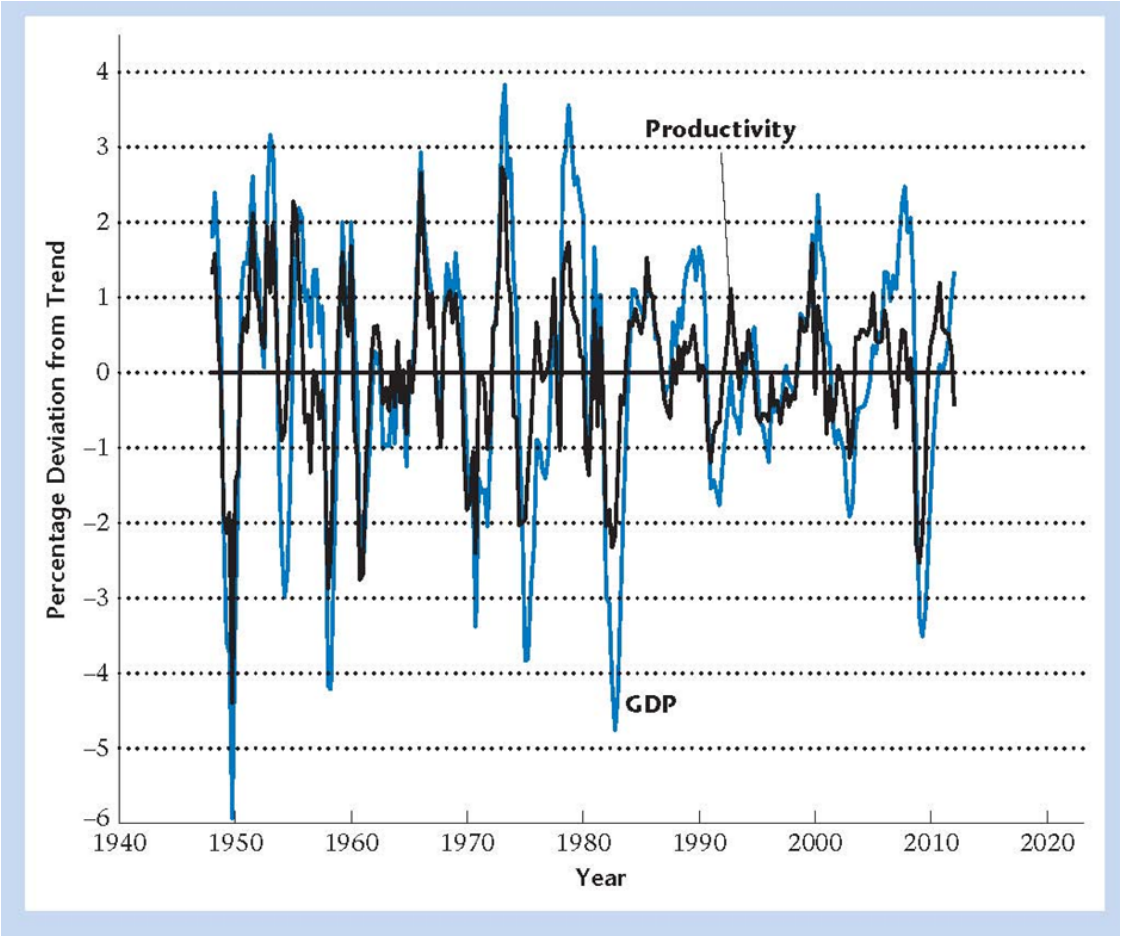
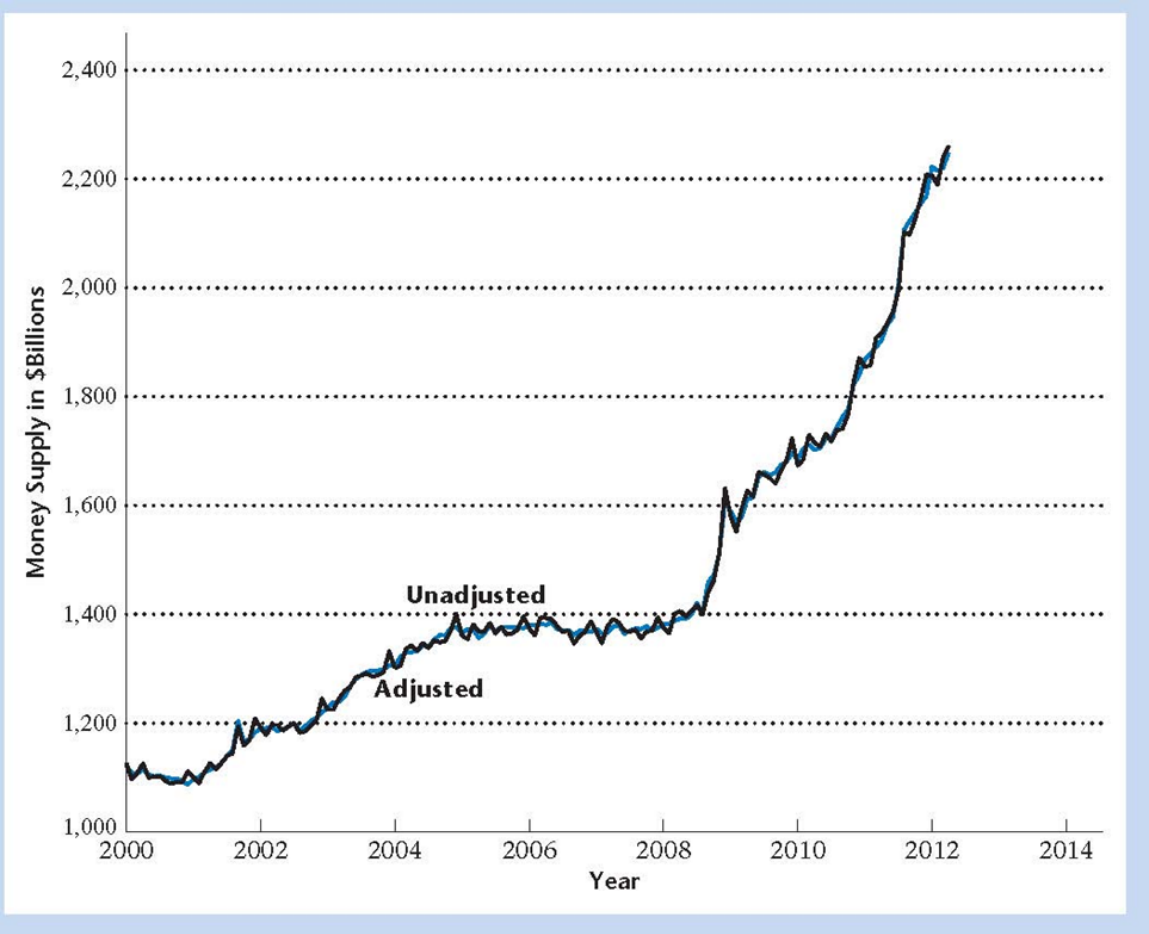


Figure 17: Seasonal Adjustment of Money Supply



Co-movement Summary 1

Table 3.1 Correlation Coefficients and Variability of Percentage Deviations from Trend

	Correlation Coefficient	Standard Deviation (% of S.D. of GDP)
Consumption	0.76	75.9
Investment	0.84	478.9
Price Level	−0.23	57.4
Money Supply	0.26	80.4
Employment	0.80	61.5
Average Labor Productivity	0.81	62.4

Co-movement Summary 2

Table 3.2 Summary of Business Cycle Facts

	Cyclicality	Lead/Lag	Variation Relative to GDP
Consumption	Procyclical	Coincident	Smaller
Investment	Procyclical	Coincident	Larger
Price Level	Countercyclical	Coincident	Smaller
Money Supply	Procyclical	Leading	Smaller
Employment	Procyclical	Lagging	Smaller
Real Wage	Procyclical	?	?
Average Labor Productivity	Procyclical	Coincident	Smaller