



ECON 310 - MACROECONOMIC THEORY

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<http://www.aw-bc.com/williamson>

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This version compiled February 5, 2014.

Chapter 3: Business Cycle Measurement

- Understand the business cycle facts and concepts of comovements

Topics

- Regularities in GDP fluctuations
- Comovement
- 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?*

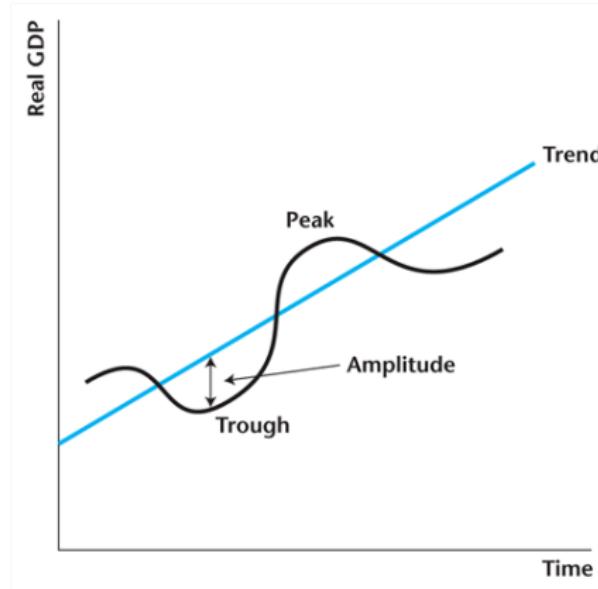
-Sir Alec Cairncross, *Essays in Economic Management*, 1971

- 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
- What is a trend/cycles?
- Growth = Trend
- Fluctuations about trend in real GDP
- Cycles = Deviations from trend
- Peaks are booms while Troughs are recessions

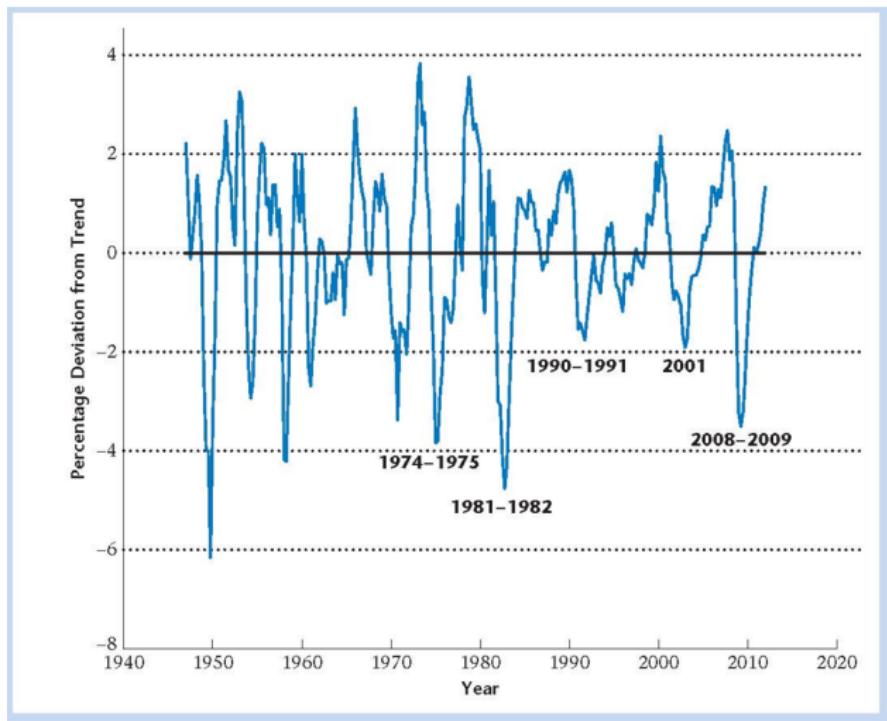
Figure 3.1: Idealized Business Cycles



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 3.2: Percentage deviations from Trend



Comovement and Correlations

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

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

Sample

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

- By definition correlation 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 3.3: Time-series plots of x and y

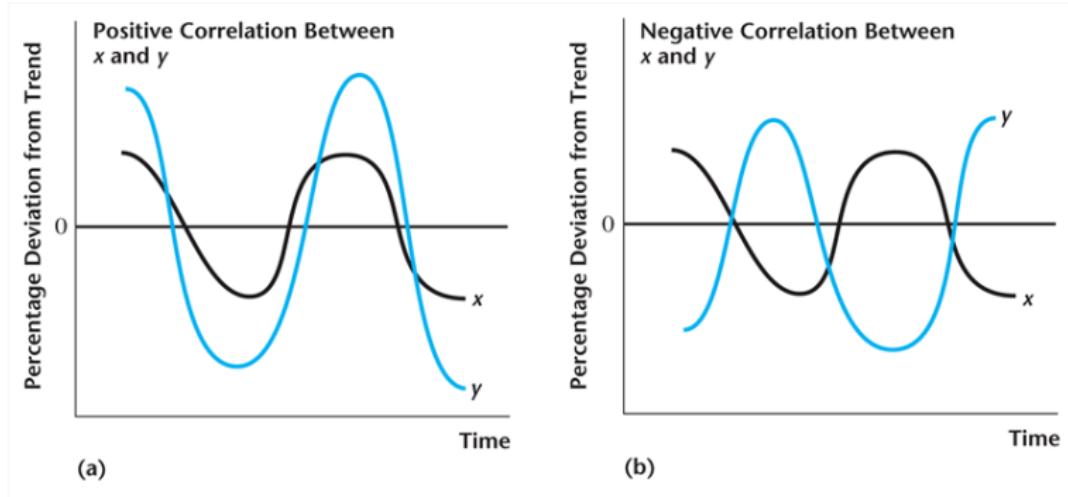
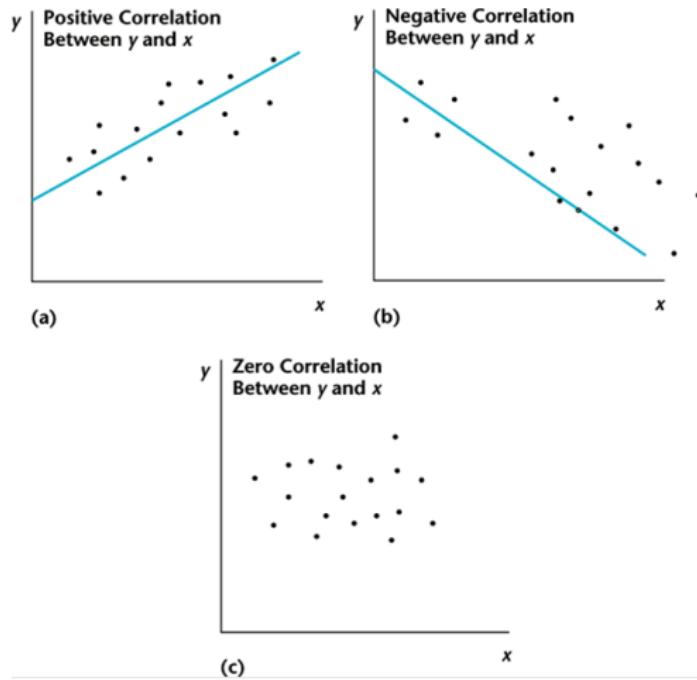


Figure 3.4: Scatter plots of x and y



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 *procyclical (countercyclical)*.
- *If a macroeconomic variable is neither procyclical nor countercyclical, it is acyclical.*

Figure 3.5: Time-series plots of Imports and GDP

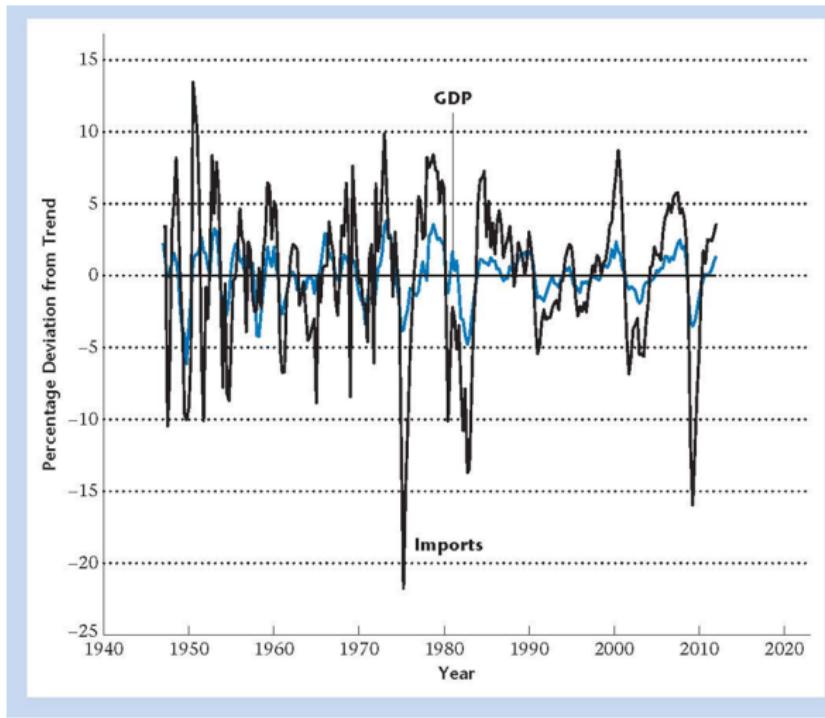
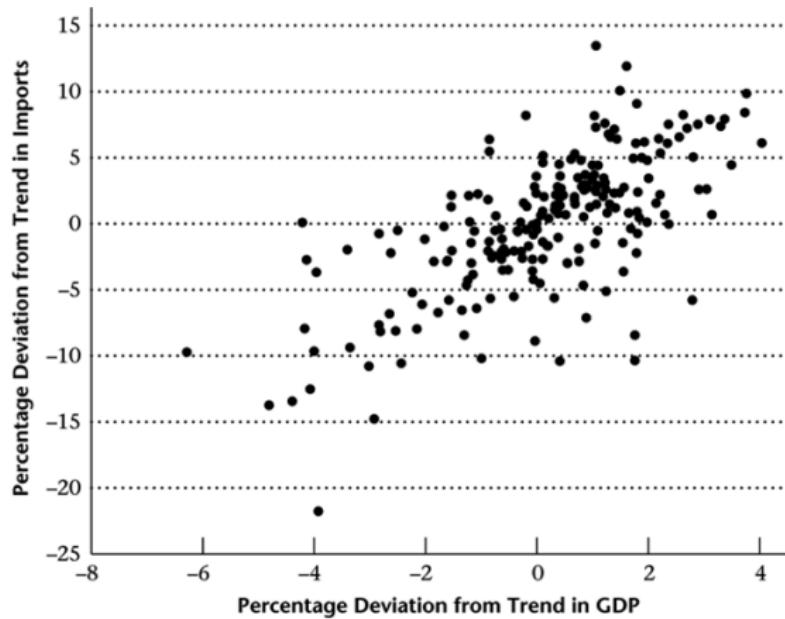


Figure 3.6: Scatter plots of Imports and GDP



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 economic indicators (Figure 3.8)
- Cyclical variability: standard deviation (square root of variance)

Figure 3.7: Leading and Lagging Variables

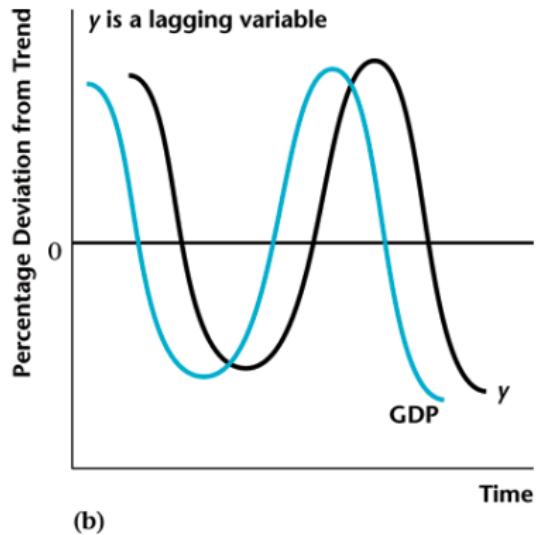
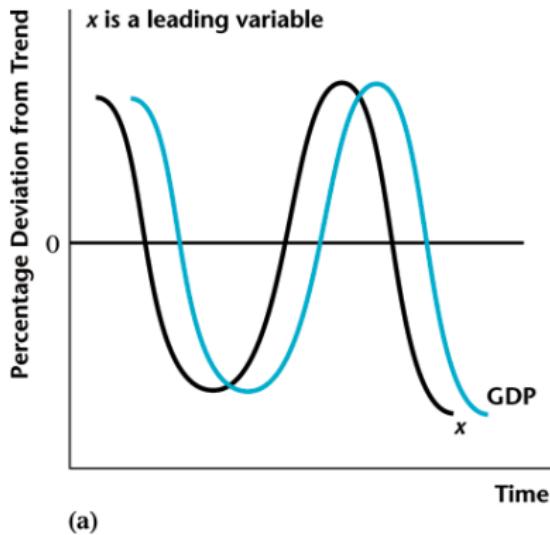
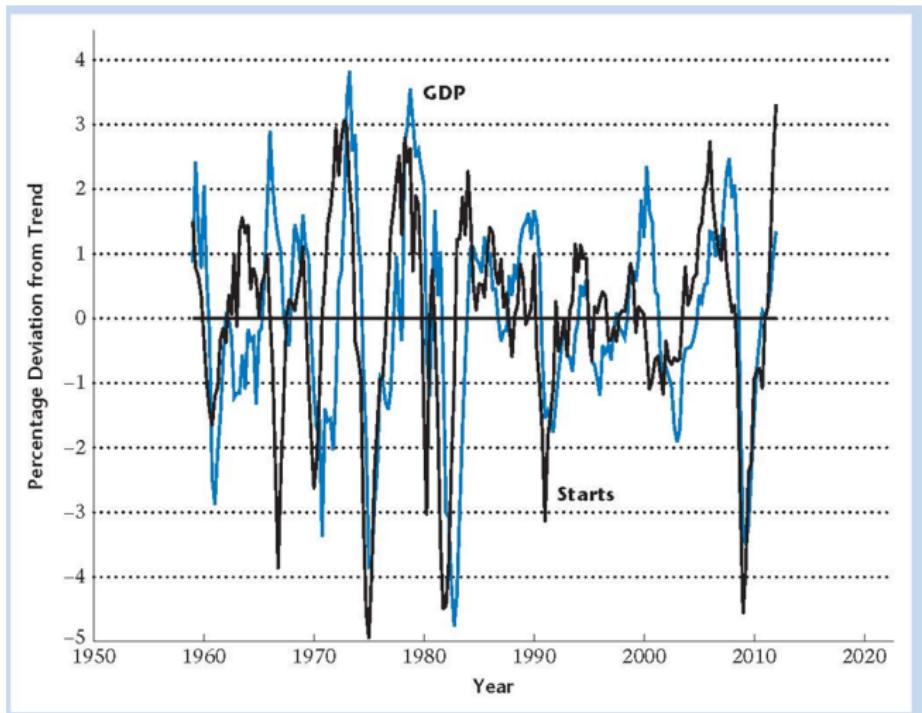


Figure 3.8: Leading Index and deviations from GDP Trend



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.

Figure 3.9: Deviations from GDP Trend and Consumption

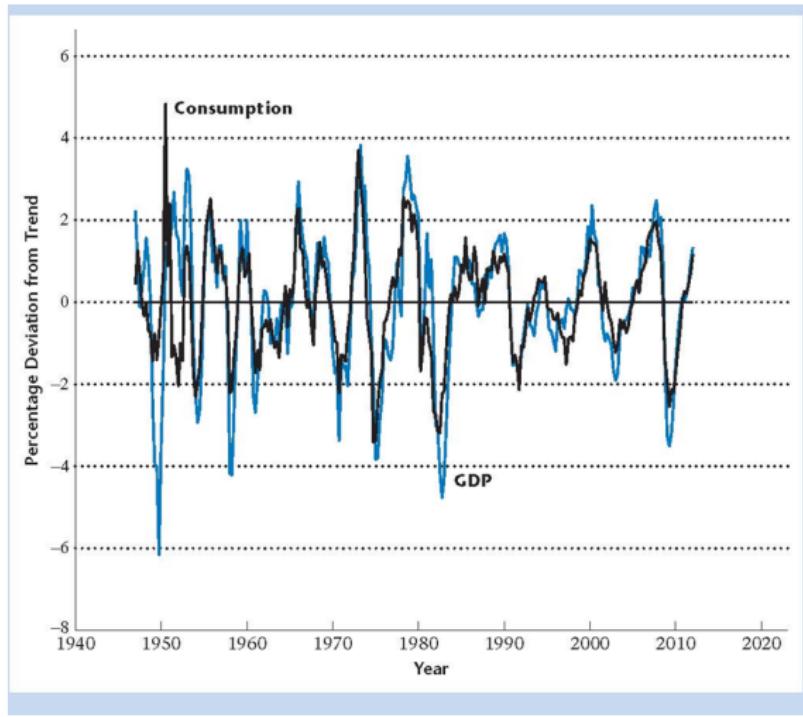
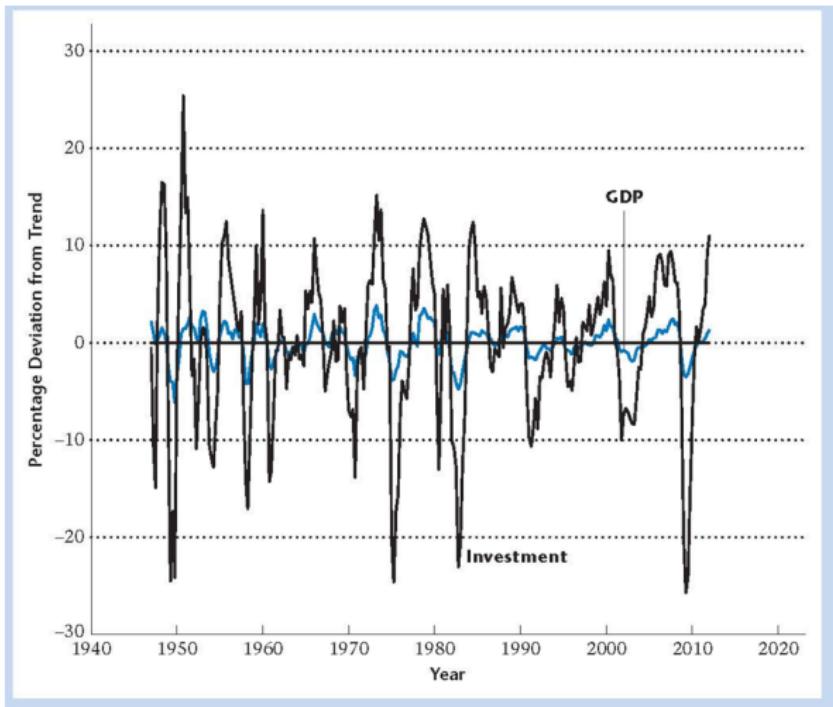


Figure 3.10: Deviations from GDP Trend and Investment



Nominal Variables

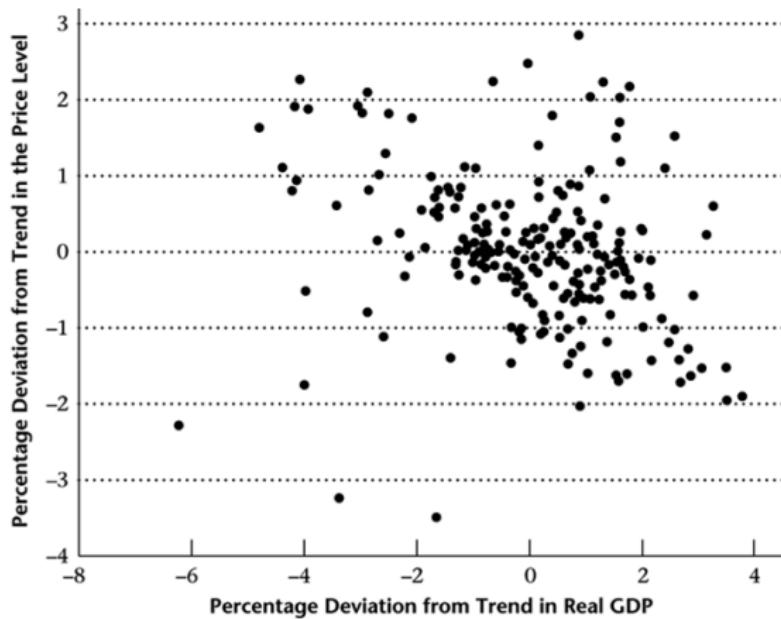
- Phillips curve
- Negative relationship between inflation and unemployment
- Short-run tradeoff (Unstable relationship)
- post hoc ergo propter hoc
- Correlation does not imply causation!
- Friedman and Schwartz: A Monetary History of the US 1867-1960
- Constructed consistent measures of money supply 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?
 - 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 3.11: Deviations from GDP Trend and Price Level



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

Figure 3.12: Deviations GDP Trend and Price Level

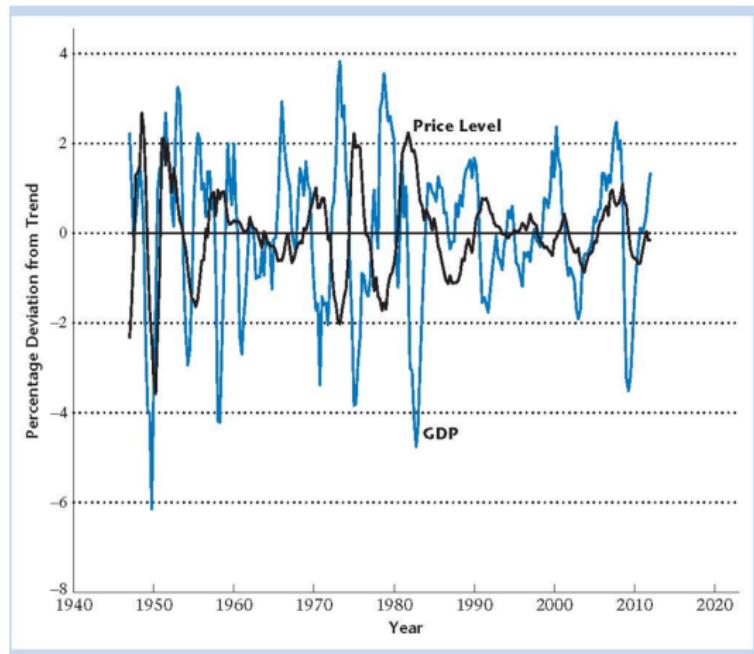
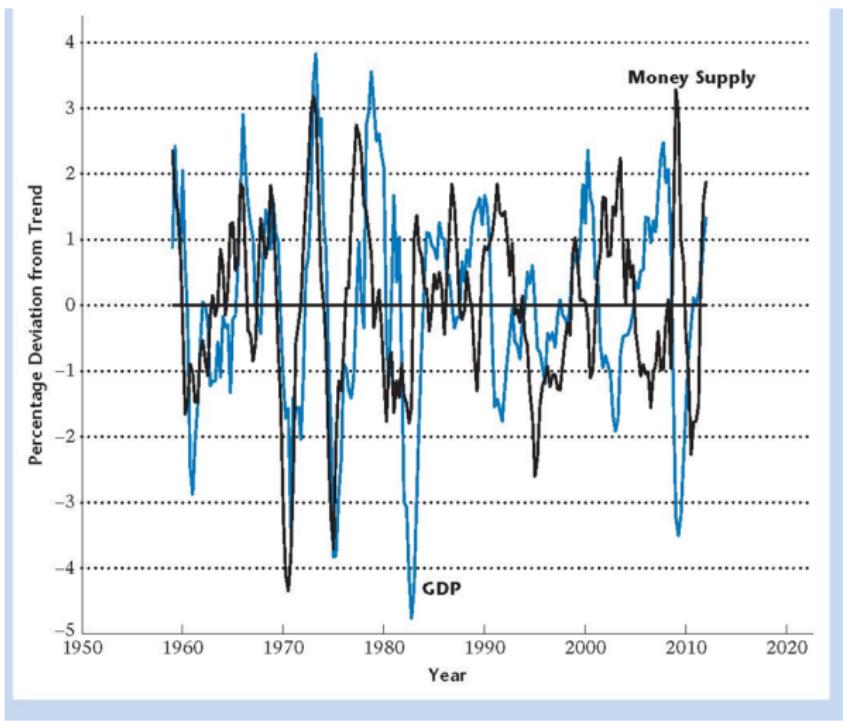


Figure 3.13: Deviations GDP Trend and Money Supply



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 3.14: Deviations GDP Trend and Employment

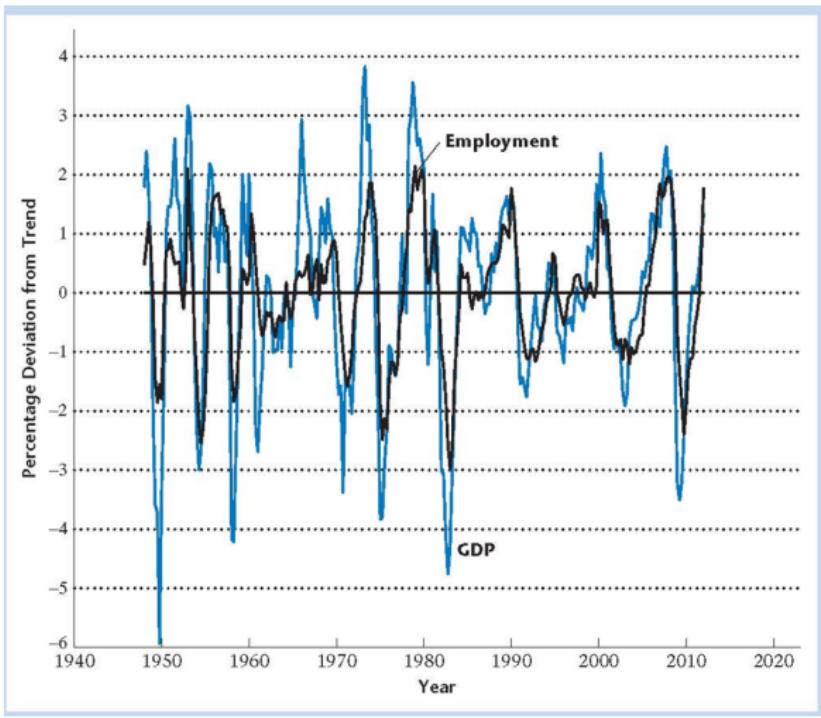


Figure 3.15: Jobless Recovery

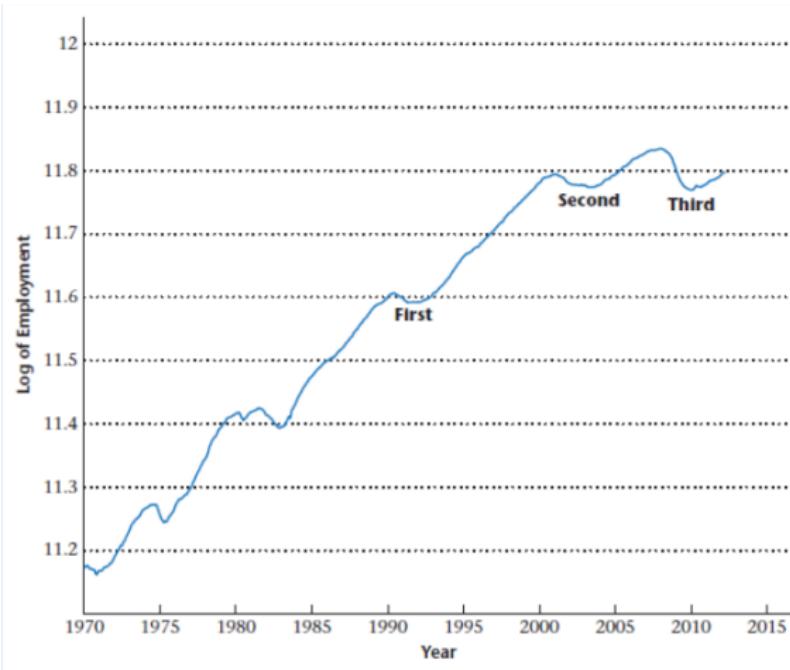


Figure 3.16: Deviations GDP Trend and E[Productivity]

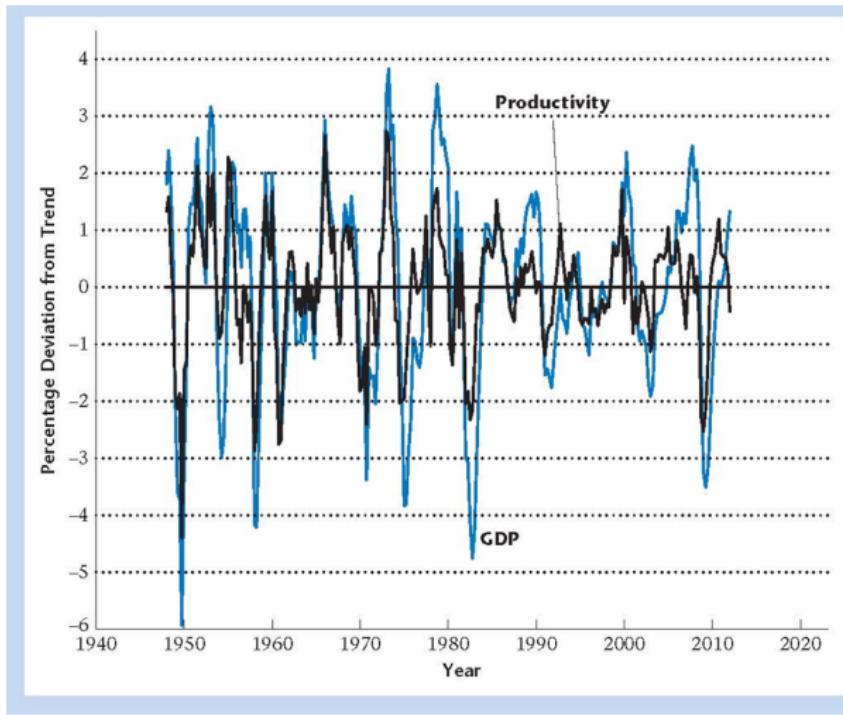
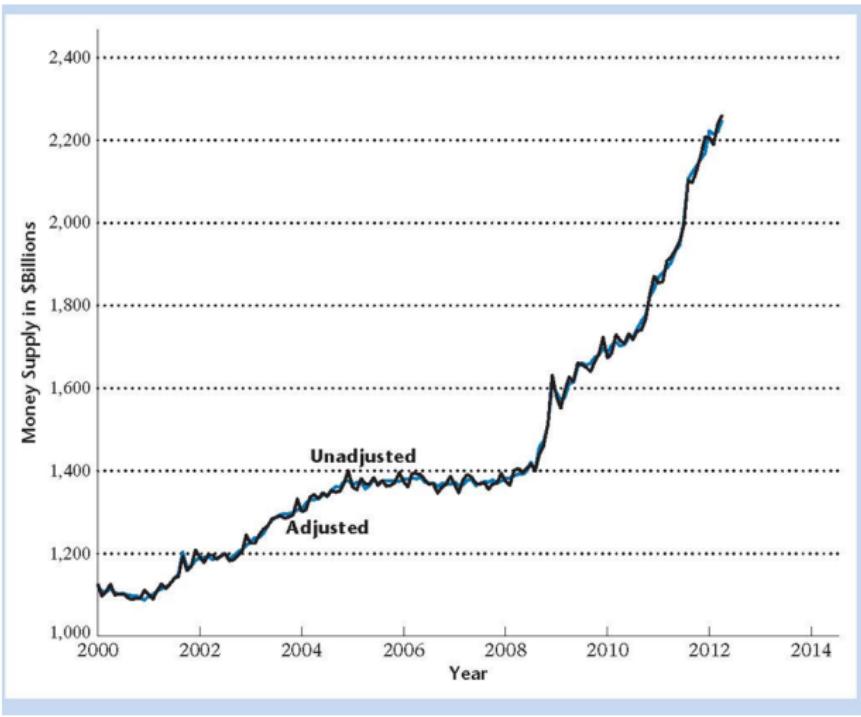


Figure 3.17: Seasonal Adjustment of Money Supply



Comovement 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

Comovement Summary 2

Table 3.2 Summary of Business Cycle Facts

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