



ECON 310 - MACROECONOMIC THEORY

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Disclaimer

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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

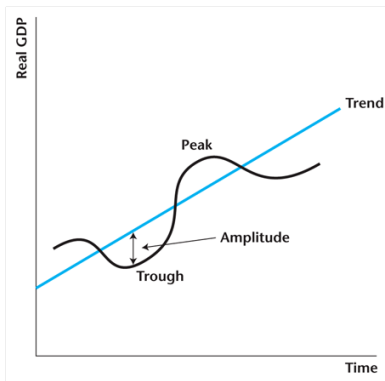
Business Cycle Measurement

- 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

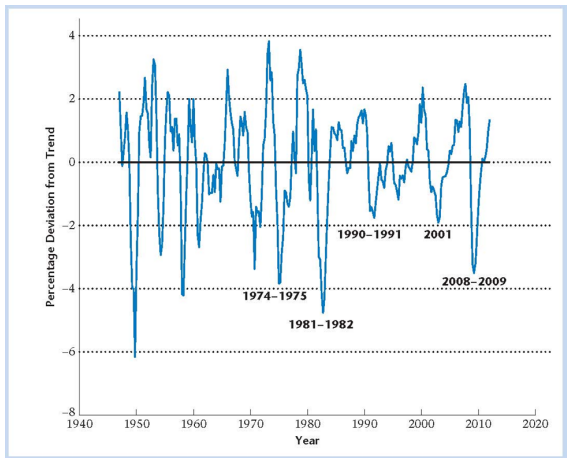
Figure 1: Idealized Business Cycles



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 Chippy
 - 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

■ Correlation

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

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

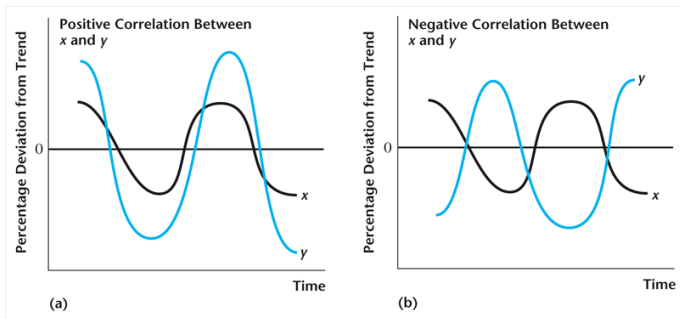


Figure 4: Scatter plots of x and y

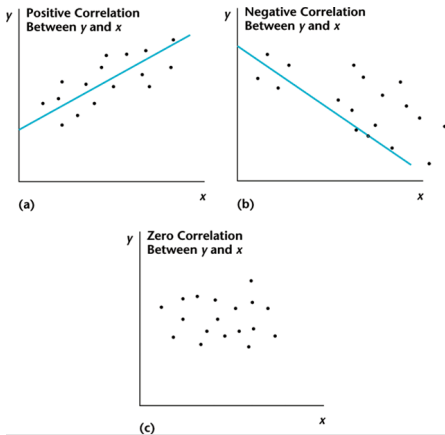


Figure 5: Time-series plots of Imports and GDP

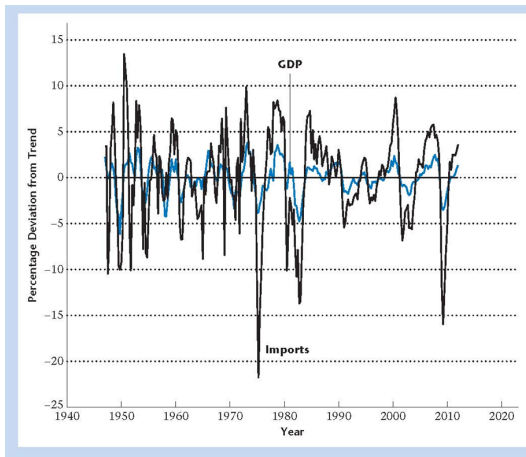
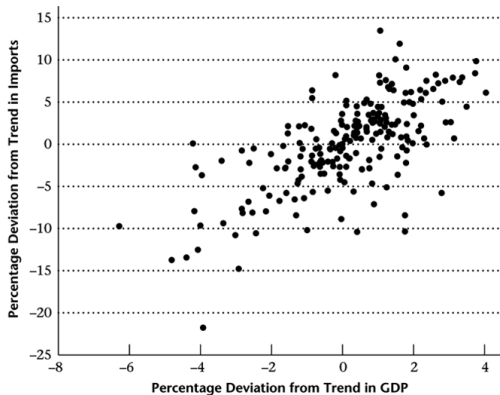


Figure 6: Scatter plots of Imports and GDP



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

Figure 7: Leading and Lagging Variables

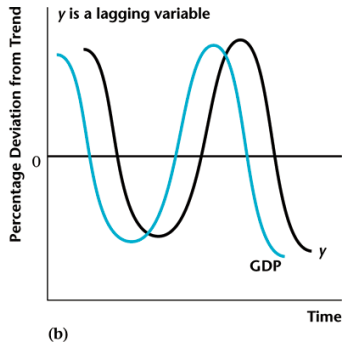
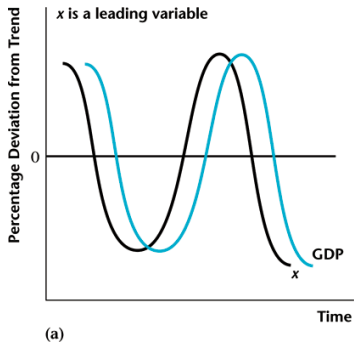
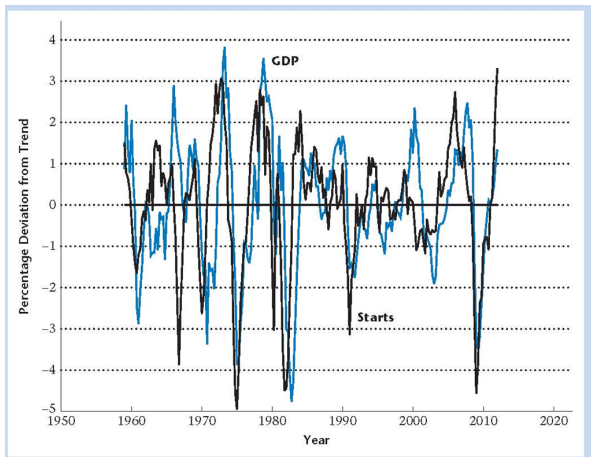


Figure 8: Leading Index and deviations from GDP Trend



Behavior of Key Macroeconomic Variables

- Components of GDP: consumption (C) and investment (I)
- Nominal variables: price level (p) and money supply (M_s)
- Labor market variables: employment, real wage ($\frac{w}{p}$), average labor productivity ($\frac{Y}{N}$)

Table 1: Macro Variables and GDP

Variable	$\rho_{x,GDP}$	Lead/Lag	$\frac{\sigma_x}{\sigma_{GDP}}$
C	0.78	coincidental	76.6%
I	0.85	coincidental	490%
p	-0.19	coincidental	56%
M_s	0.2	Lead	81%
Empl.	0.8	Lag	63%
$\frac{w}{p}$	+	?	?
$\frac{Y}{N}$	0.8	coincidental	62.8

Behavior of Key Macroeconomic Variables (cont.)

Figure 9: Leading Index and deviations from GDP Trend

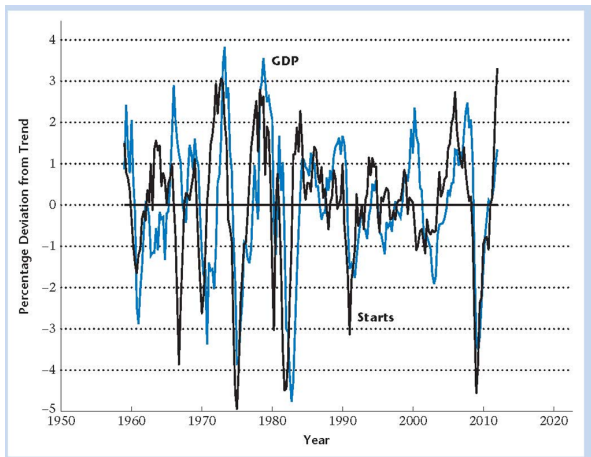


Figure 10: Deviations from GDP Trend and Investment

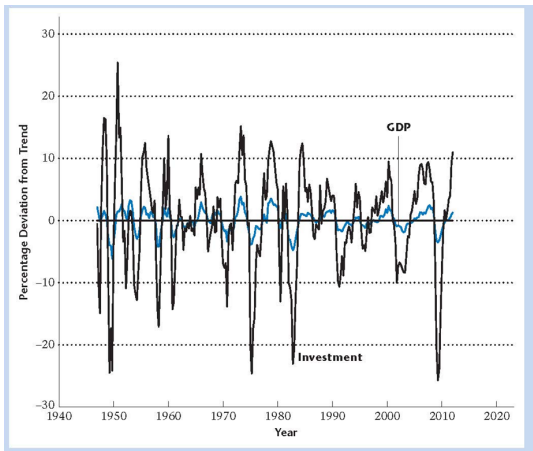
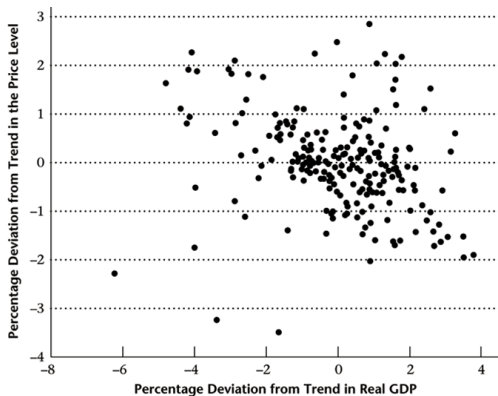


Figure 11: Deviations from GDP Trend and Price Level



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

Figure 12: Deviations GDP Trend and Price Level

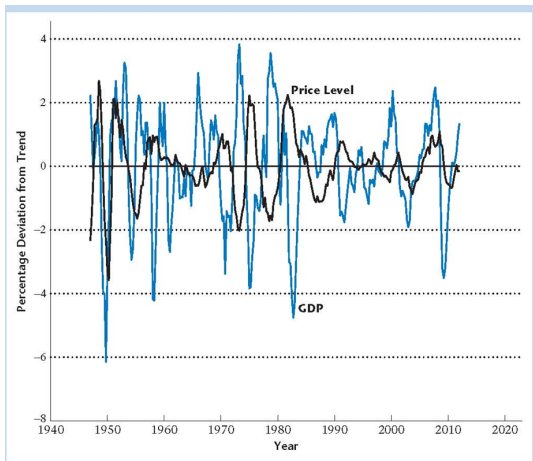
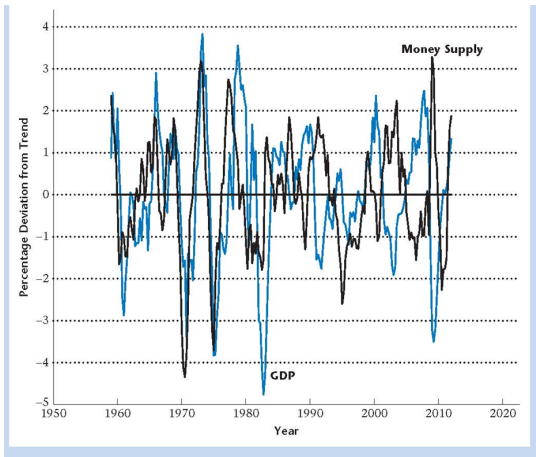


Figure 13: Deviations GDP Trend and Money Supply



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

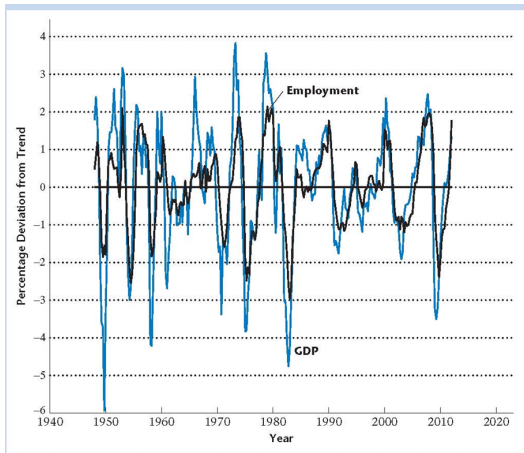


Figure 15: Jobless Recovery

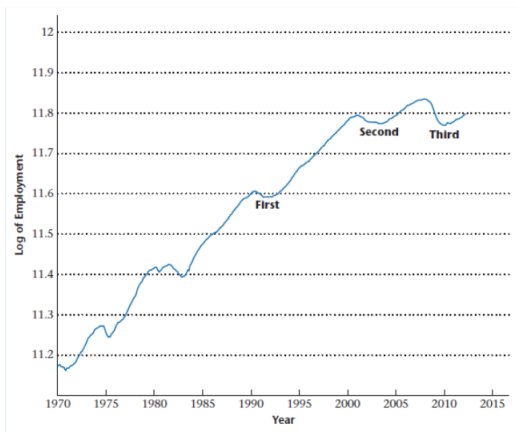


Figure 16: Deviations GDP Trend and $E[\text{Productivity}]$

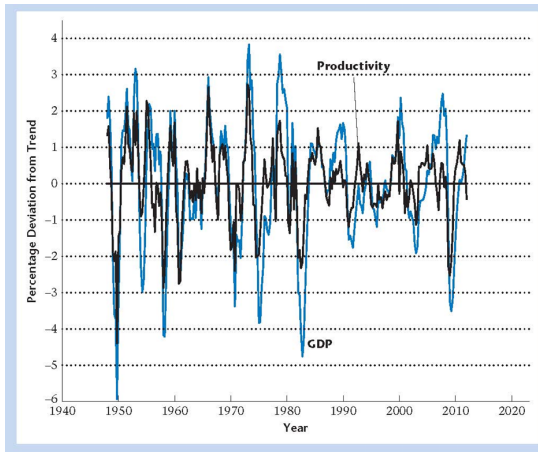
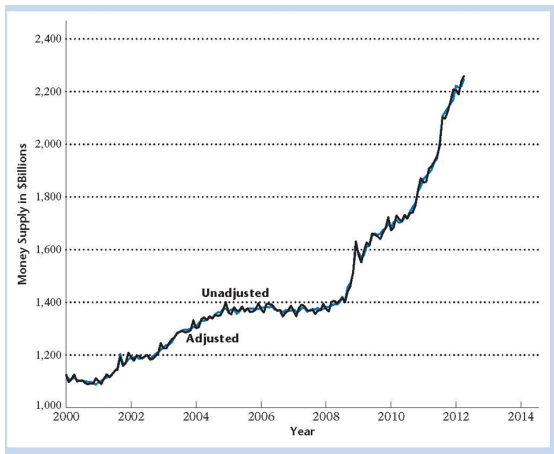


Figure 17: Seasonal Adjustment of Money Supply



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

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Co-movement Summary 2

Table 3.2 Summary of Business Cycle Facts

	Cyclicity	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