BUSINESS CYCLE MEASUREMENT

Goals

- Introduce some terminology used in discussing business cycles
- Introduce some simple statistical concepts we will use to examine the empirical implications of models we develop.
- Introduce the idea of leading indicators
- Generate some business cycle "facts."

Regularities in GDP Fluctuations

- Business cycles are fluctuations about trend
- A Peak is the largest positive deviation from trend
- A trough is the largest negative deviation from trend
- The amplitude of a business cycle is the size of the maximum deviation from trend

Figure 3.1 Idealized Business Cycles

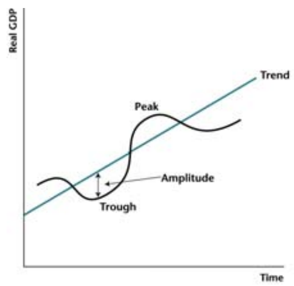
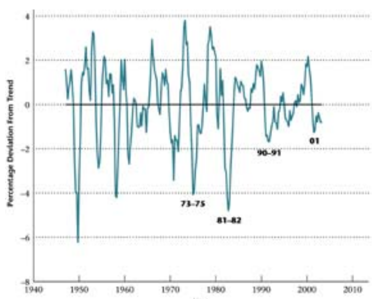


Figure 3.2 Percentage Deviations from Trend in Real GDP from 1947--2003



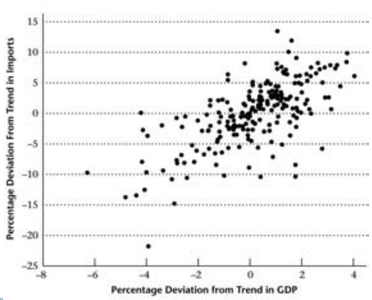
What should we learn from Figure 3.2?

- Deviations from trend are persistent- when real GDP is above trend, it tends to stay above trend.
- There is no regularity in the amplitude of fluctuations in real GDP about trend.
- There is no regularity in the frequency of fluctuations in real GDP about trend.

Macroeconomic variables fluctuate together in patterns that exhibit strong regularities or comovements.

- How do we determine if two series move together?
- Scatter Plots
- Correlation Analysis

Figure 3.6 Scatter Plot of Imports and GDP



Correlation Analysis

- Plot the two series over time
- A measure of the degree of correlation between two variables is the correlation coefficient which takes on values between –1 and 1.
- A correlation coefficient of 1 means the two variables are perfectly correlated.
- A correlation coefficient of –1 means the two variables are perfectly negatively correlated.

Figure 3.3 Time Series Plots of x and y

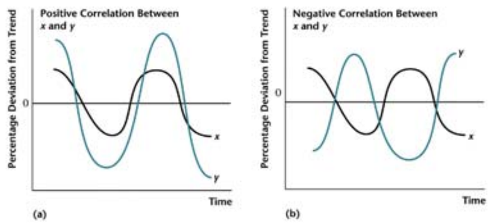
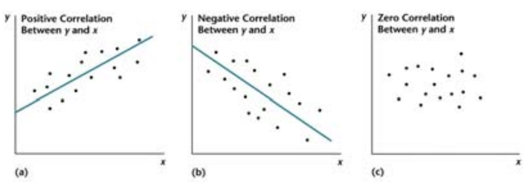


Figure 3.4 Correlations Between Variables y and x



The correlation coefficient

- Formula:

- Corr(x,y)= (1/n-1)*E[(x-xbar)(y-ybar)]
  std(x)*std(y)

xbar = mean of x

Std(x) = standard deviation of x

Example

Year	GDP	CONS
1998	9088.7	6125.8.
1999	9504.7	6438.6
2000	9855.9	6739.4
2001	9901.4	6904.6
2002	10105	7104.0
Total	48455.7	33312.4
Mean-average	9691.14	6662.48

Step 1 – calculate mean of Y and C

ybar = $\frac{\text{Ey}}{n}$ = $\frac{48455.7}{5}$ = 9691.4

cbar = $\frac{\text{Ey}}{n}$ = $\frac{33312.4}{5}$ = 6662.48

Step 2- Calculation sample covariance

$S_{xy} = \frac{\text{E(y-ybar)(x-xbar)}}{\text{n-1}}$

$= \frac{611366.642}{4}$

= 152841.66

Example

Year	Y-Ybar	X-Xbar	(Y-Ybar)(X-Xbar)
1998	-602.44	-536.68	323317.49
1999	-186.44	-223.88	41740.187
2000	164.76	76.92	12673.339
2001	210.26	242.12	50908.15
2002	413.86	441.52	182727.467
Total			611366.642

Step 3-Calculate sample variances

$$S^2_y = \frac{E(y\text{-}ybar)}{n-1} = \frac{640329.052}{4} = 160682.263$$

$$S^2_x = \frac{E(x\text{-}xbar)}{n-1} = \frac{597626.368}{4} = 149406.592$$

Step4 –calculate sample correlation coefficient

- $$\text{Corr}(x,y) = \frac{s_{xy}}{s_y\, s_x} = \frac{152841.66}{(400.1028)(386.531)} = .9882$$

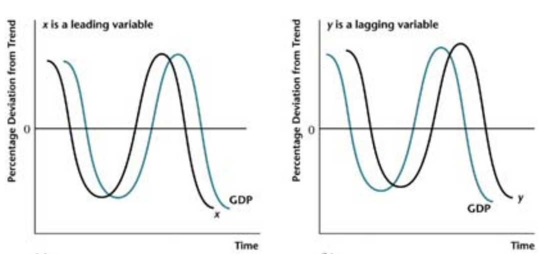
Example

Year	(y-ybar)^2	(x-xbar)^2
1998	362933.9536	288025.4224
1999	34759.8736	50122.2544
2000	27145.8576	5916.6864
2001	44209.2676	58622.0944
2002	171280.0996	194939.9104
total	640329.052	597626.3680

Correlation and Leading Indicators

- Leading variable – a variable that predicts the future path of a variable
- Lagging variable – a variable that moves after another variable
- Coincident variable-a variable that neither leads or lags another variable

Figure 3.7 Leading and Lagging Variables



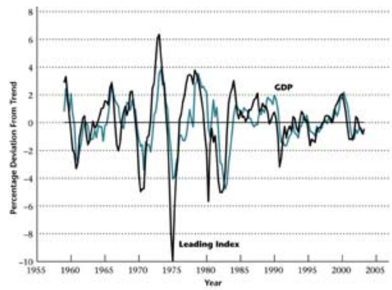
What are some of the variables that enter the Index of Leading Indicators?

- Average weekly manu. Hours(0.1965)
- Average weekly unemployment insurance claims(0.0252)
- Manufacturers new orders, consumer goods(0.0588)
- Vendor deliveries diffusion index(0.0292)

- Manufacturers' new capital goods orders(nondefense) (0.0146)
- New private housing permits(0.0202)
- Stock Price Index(0.0291)
- Money Supply(M2) (0.2774)
- Interest Rate Spread(10 yr. Tbill-Fed Funds(0.3303)

- Index of consumer expectations(0.0188)

Figure 3.8 Percentage Deviations from Trend in Real GDP (colored line) and the Index of Leading Economic Indicators (black line) for 1959–2003



Business Cycle Facts

Business Cycles are the deviation of RGDP from Trend

- Business Cycle Facts must be bases on trend adjusted data
- Business Cycle Effect = Data – Trend
- Trend is simply a straight line through the data
- Correlations should be based on trend adjusted data

Figure 3.9 Percentage Deviations from Trend in Real Consumption (black line) and Real GDP (colored line)

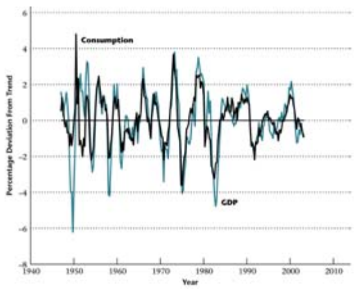


Figure 3.12 Price Level and GDP

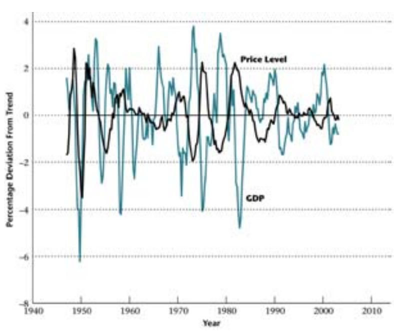


Figure 3.13 Percentage Deviations from Trend in the Money Supply (black line) and Real GDP (colored line) for the Period 1959–2003

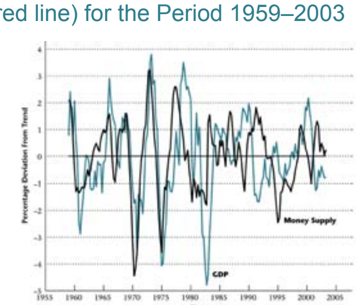


Table 3.1 Correlation Coefficients and Variability of Percentage Deviations from Trend

	Correlation Coefficient	Standard Deviation (% of S.D. of GDP)
Consumption	0.76	75.6%
Investment	0.83	469.2
Price Level	−0.26	57.6
Money Supply	0.38	77.9
Employment	0.81	59.3
Average Labor Productivity	0.83	62.8

Table 3.2 Summary of Business Cycle Facts

	Cyclicality	Lead/Lag	Variability 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