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ECON 202

Lecture 2:
Business Cycles

What is a Business Cycle?

Business cycles are fluctuations about trend in real GDP

- Irregular:

– Business cycles are unpredictable

- Regular:

– Macro variables usually move together in quite predictable ways

Terminology of Business Cycles

- **Trend**:

– Smooth curve/line that closely fits actual real GDP

– Represents long-run growth

- **Peak / trough**:

– Relatively large positive / negative deviation from the trend

Terminology of business cycles

- **Amplitude**:

– Maximum deviation from the trend

- **Frequency**:

– Number of peaks per year

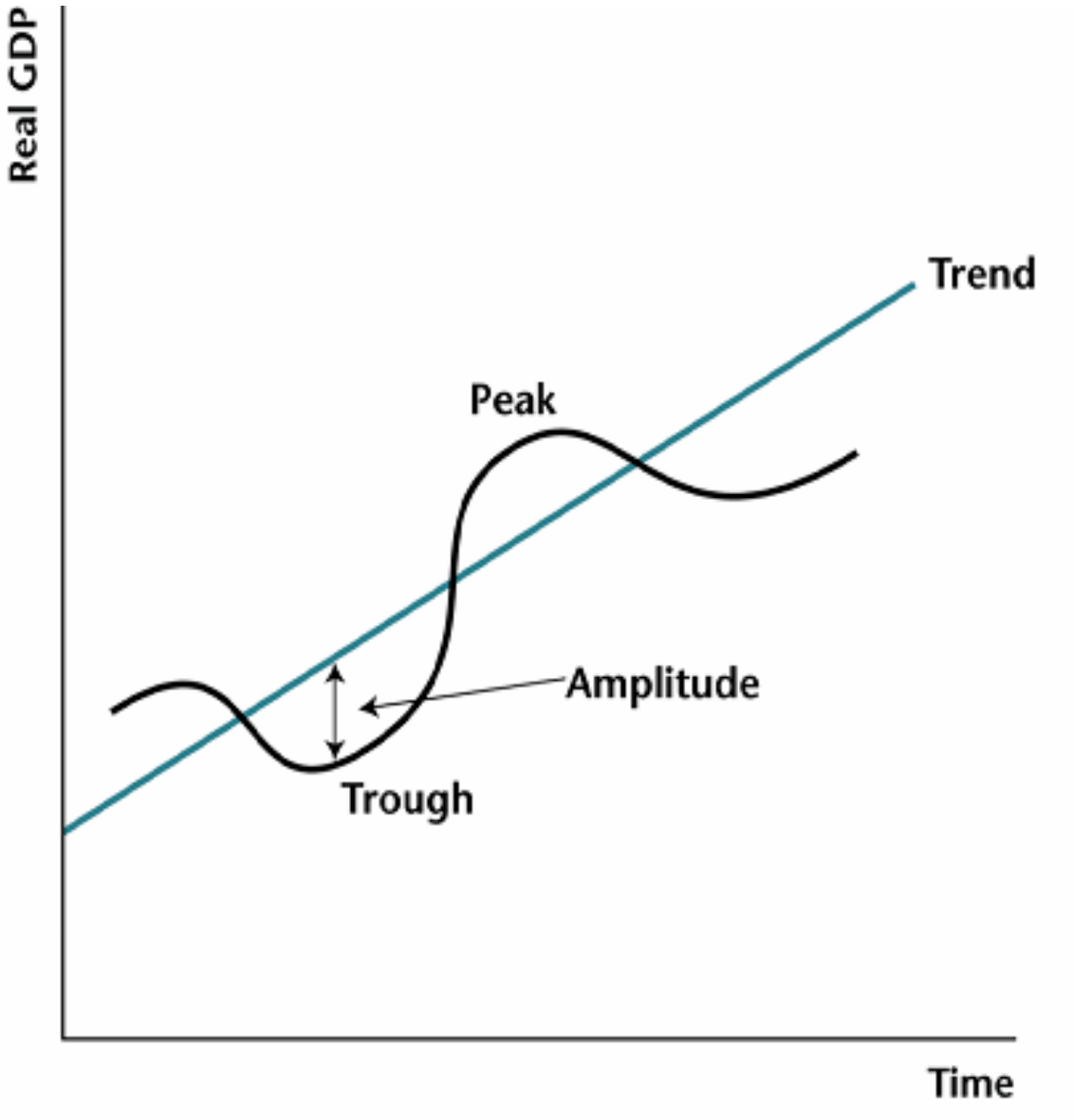
- **Boom**:

– A series of positive deviations culminating in a peak

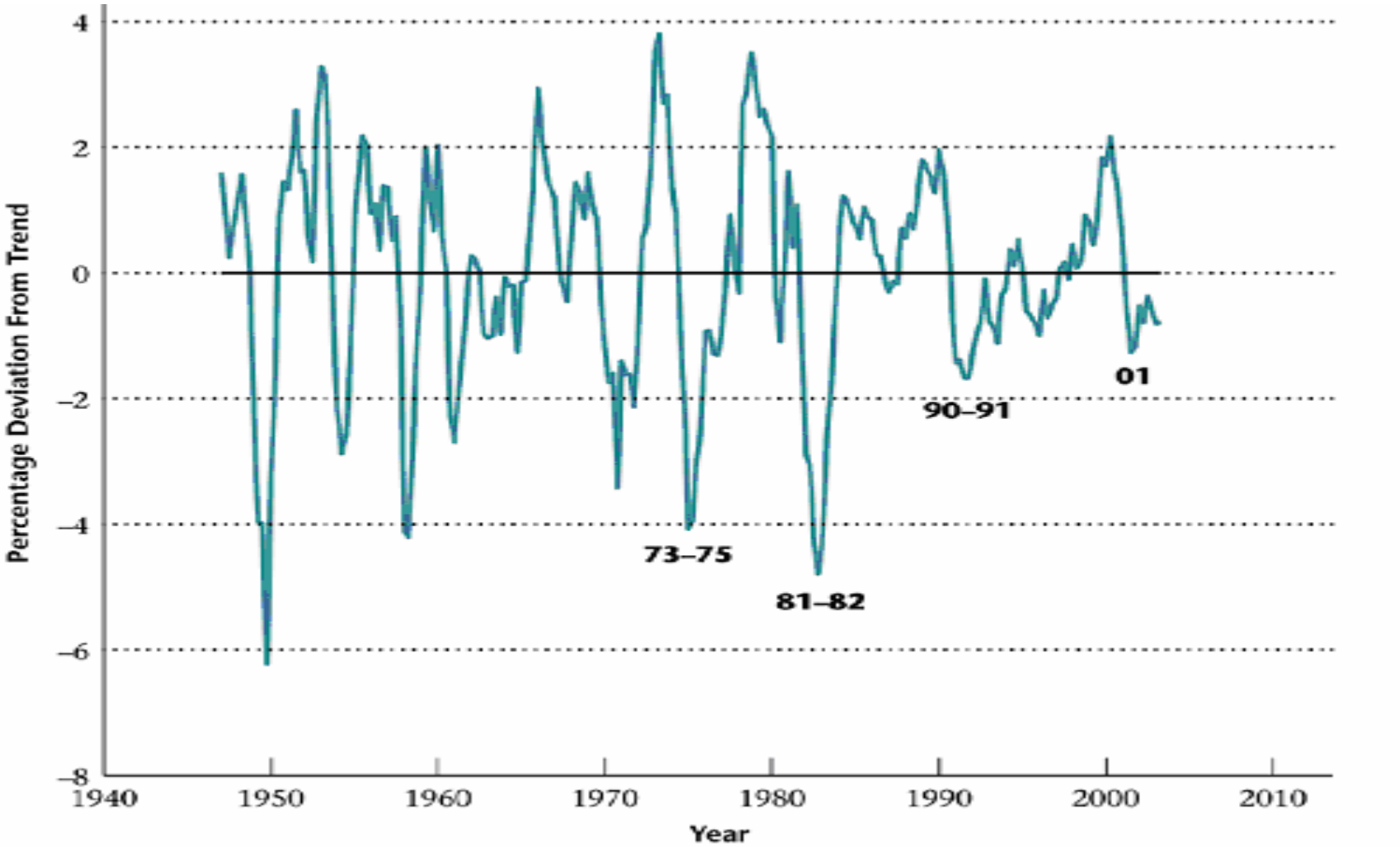
- **Recession**:

– A series of negative deviations culminating in a trough

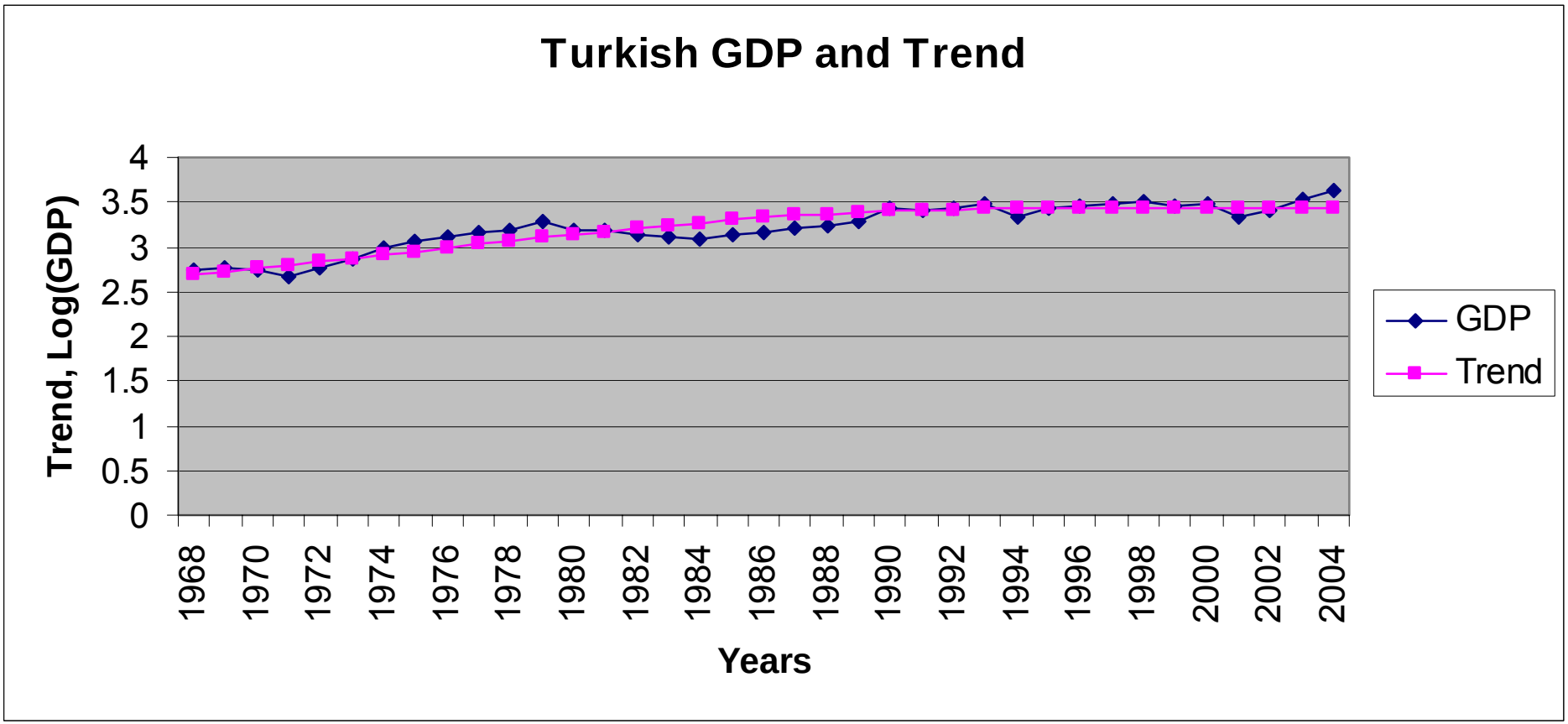
Idealized Business Cycles



Percentage Deviations from Trend in Real GDP from 1947– 2003, US Data

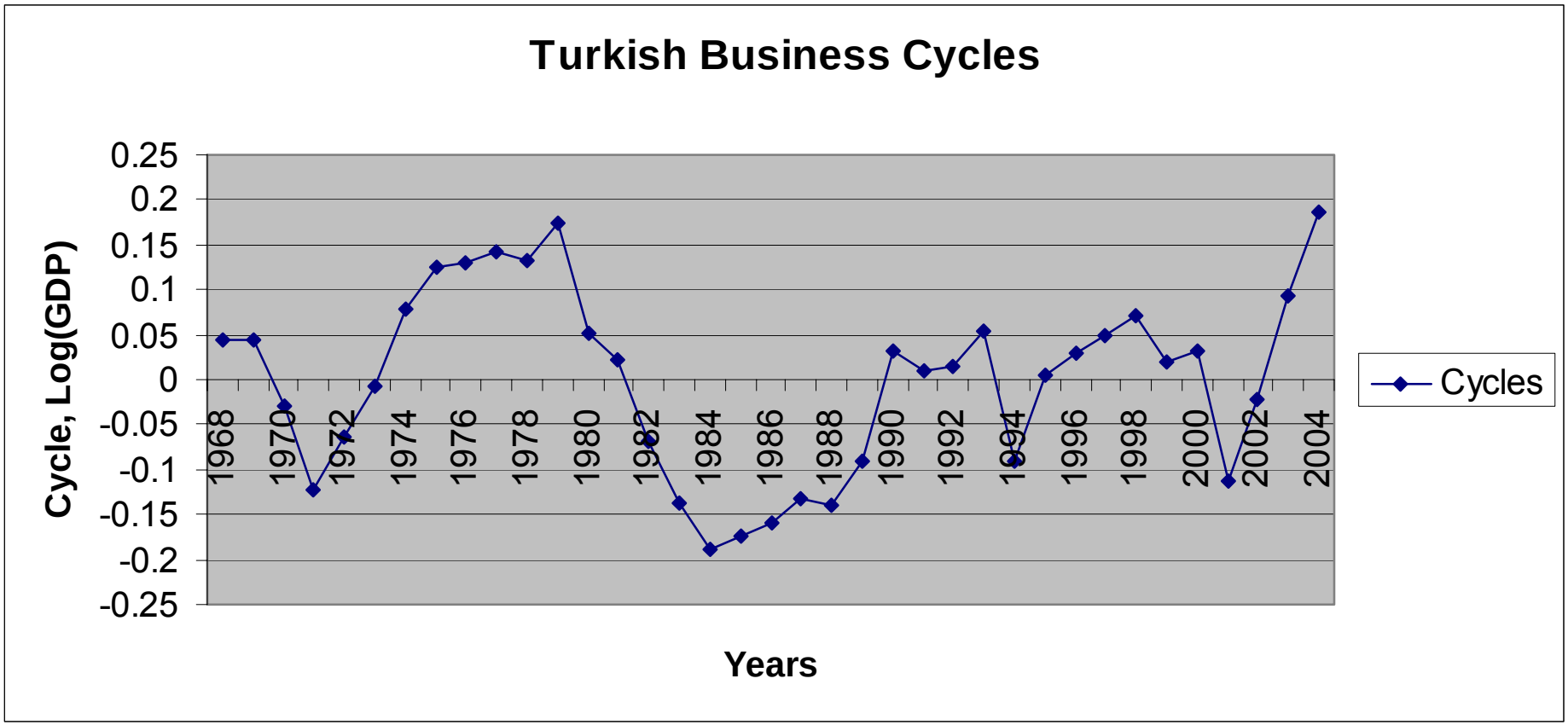


Trend in Real GDP from 1968– 2004, Turkish Data



Not deseasonalized, presented for pedagogical purposes

Percentage Deviations from Trend in Real GDP from 1968– 2004, Turkish Data*



*Not deseasonalized, presented for pedagogical purposes

De-trending (HP Filter)

The Hodrick-Prescott Filter:

$$HP = \sum_{t=1}^{T} (y_t - g_t)^2 + \lambda \sum_{t=2}^{T-1} \left[(g_{t+1} - g_t) - (g_t - g_{t-1}) \right]^2$$

λ: 100 (Yearly Data)

λ: 1600 (Quarterly Data)

λ: 14400 (Monthly Data)

Evidence in the data

- Persistent fluctuations
- Deviations are not smooth
- Variability of amplitudes
- Irregular frequency of the business cycles
- Regular co-movements of some macro variables

Evidence in the data

- Co-movements:

– How variables move in respect to another variable (real GDP in BCs literature)

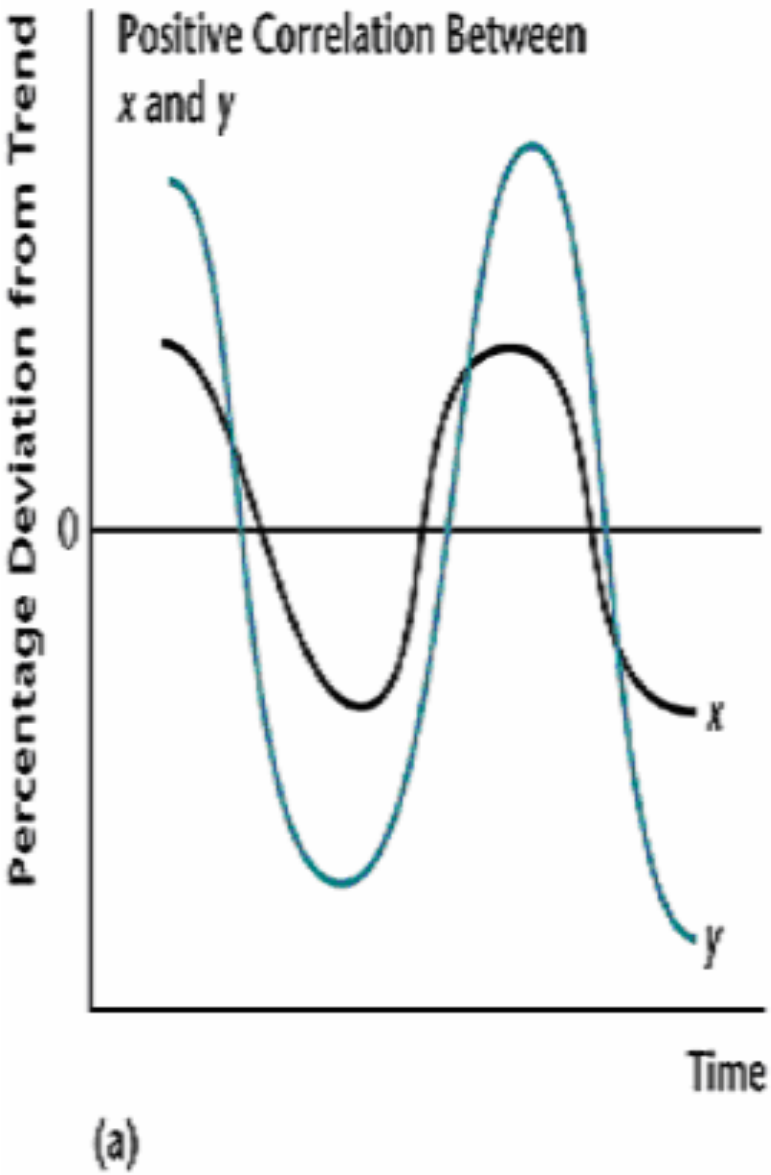
– We measure co-movements by estimating correlations between variables

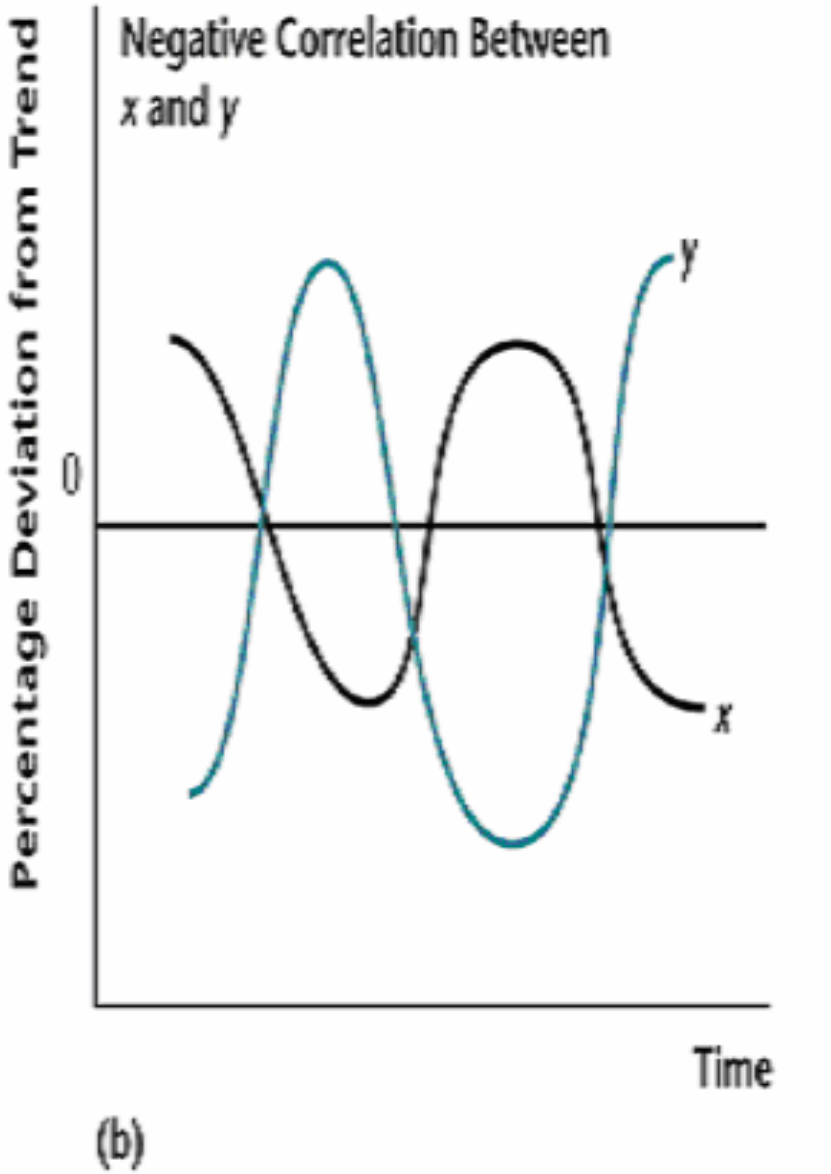
- Correlation: $-1 < \rho < 1$

– correlation can be positive/negative

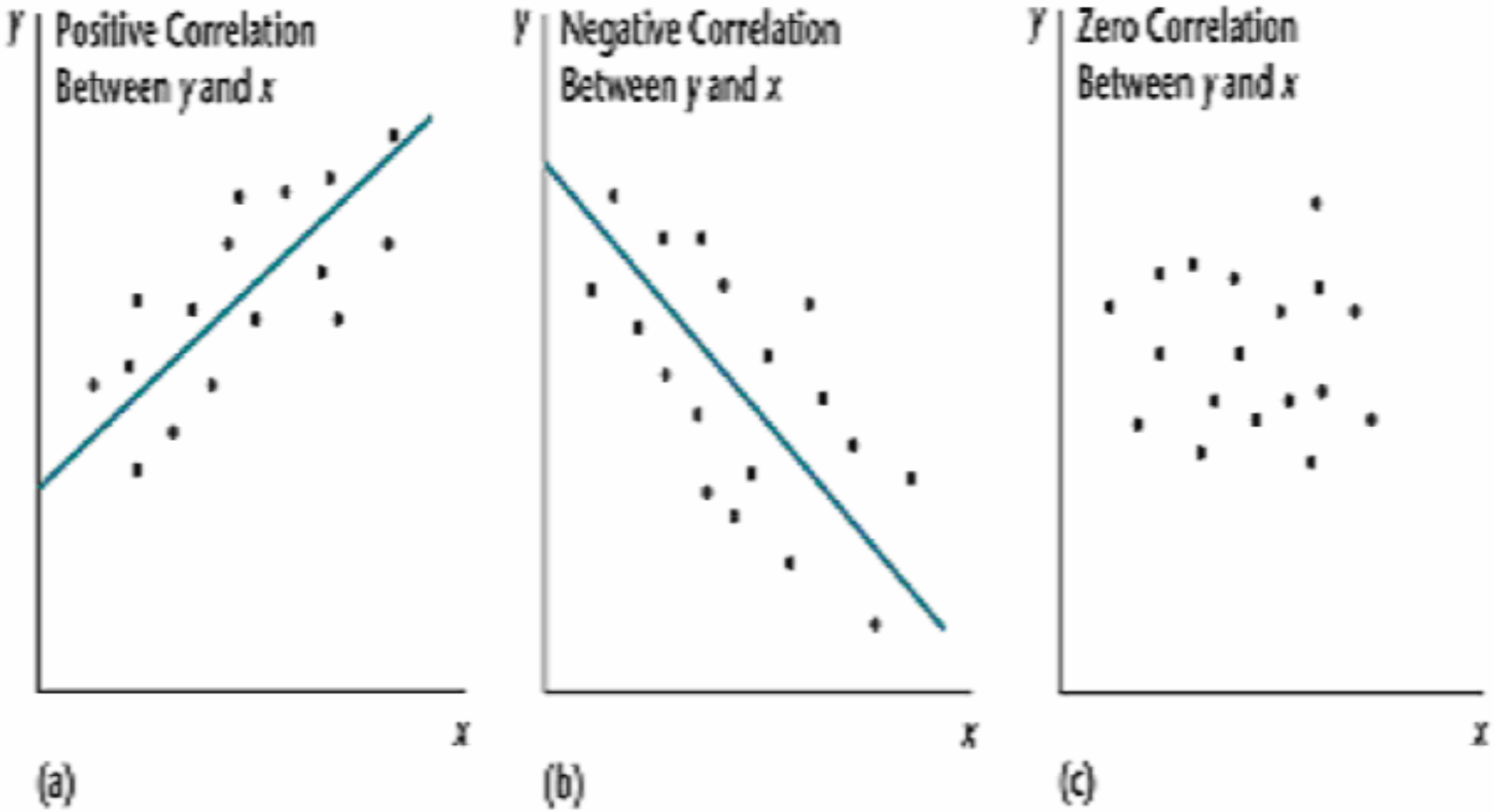
– Strong/weak

Time Series Plots of x and y





Correlations Between Variables y and x



Correlation

- Procyclical:

– Variables move the same direction as RGDP

– Positive correlation with deviations from trend in RGDP

- Countercyclical:

– Variables move opposite direction as RGDP

– Negative correlation with deviations from trend in RGDP

- Acyclical:

– Correlation is close to zero (positive or negative)

Comovements

The coefficient of correlation:

$$\rho(x_t, c_t) = \frac{s_{xc}}{s_x s_c} = \frac{\sum_{t=1}^{T}(x_t - \bar{x})(c_t - \bar{c})}{\sqrt{\sum_{t=1}^{T}(x_t - \bar{x})^2}\sqrt{\sum_{t=1}^{T}(c_t - \bar{c})^2}}$$

S_{xc} is covariance between x_t and c_t

S_x is the standard deviation of the estimated cyclical component of variable x

S_c is the standard deviation of the estimated cyclical component of RGDP

Definitions

$$s_{xc} = \frac{1}{1-T}\sum_{t=1}^{T}(x_t - \bar{x})(c_t - \bar{c})$$

$$\bar{x} = \frac{1}{T}\sum_{t=1}^{T} x_t \qquad \bar{c} = \frac{1}{T}\sum_{t=1}^{T} c_t$$

$$s_x = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(x_t - \bar{x})^2} \qquad s_c = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(c_t - \bar{c})^2}$$

Leads and lags

- Leading variable:

– A variable that tends to predict future movements in RGDP

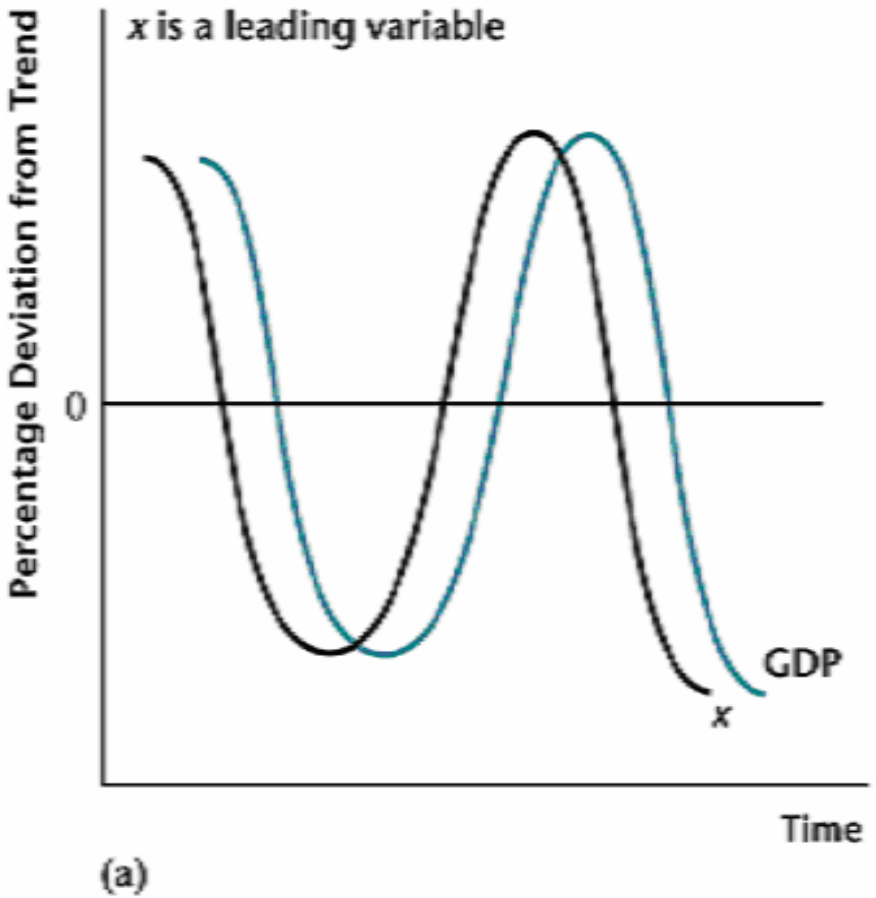
- Lagging variable:

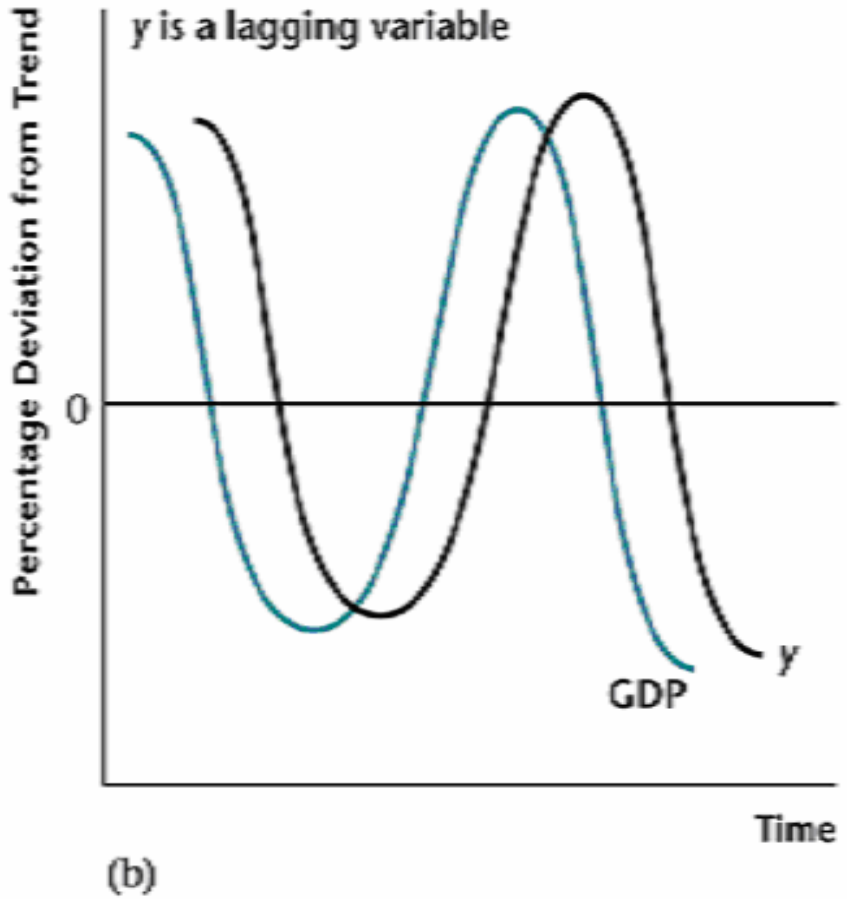
– Future movements of the variable can be predicted by movements in RGDP

- Coincident variable:

– Is not either leading nor lagging

Leading and Lagging Variables





Lead / Lag

X is a leading indicator if

$$\rho(x_{t-n}, c_t)$$

is significantly different from zero and numerically greater than $\rho(x_t, c_t)$

X is a lagging indicator if

$$\rho(x_{t+n}, c_t)$$

is significantly different from zero and numerically greater than $\rho(x_t, c_t)$

Volatility

Absolute volatility:

$$s_x = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(x_t - \bar{x})^2}$$

Relative volatility

$$\frac{s_x}{s_c}$$